SEVENTY-FOURTH YEAR

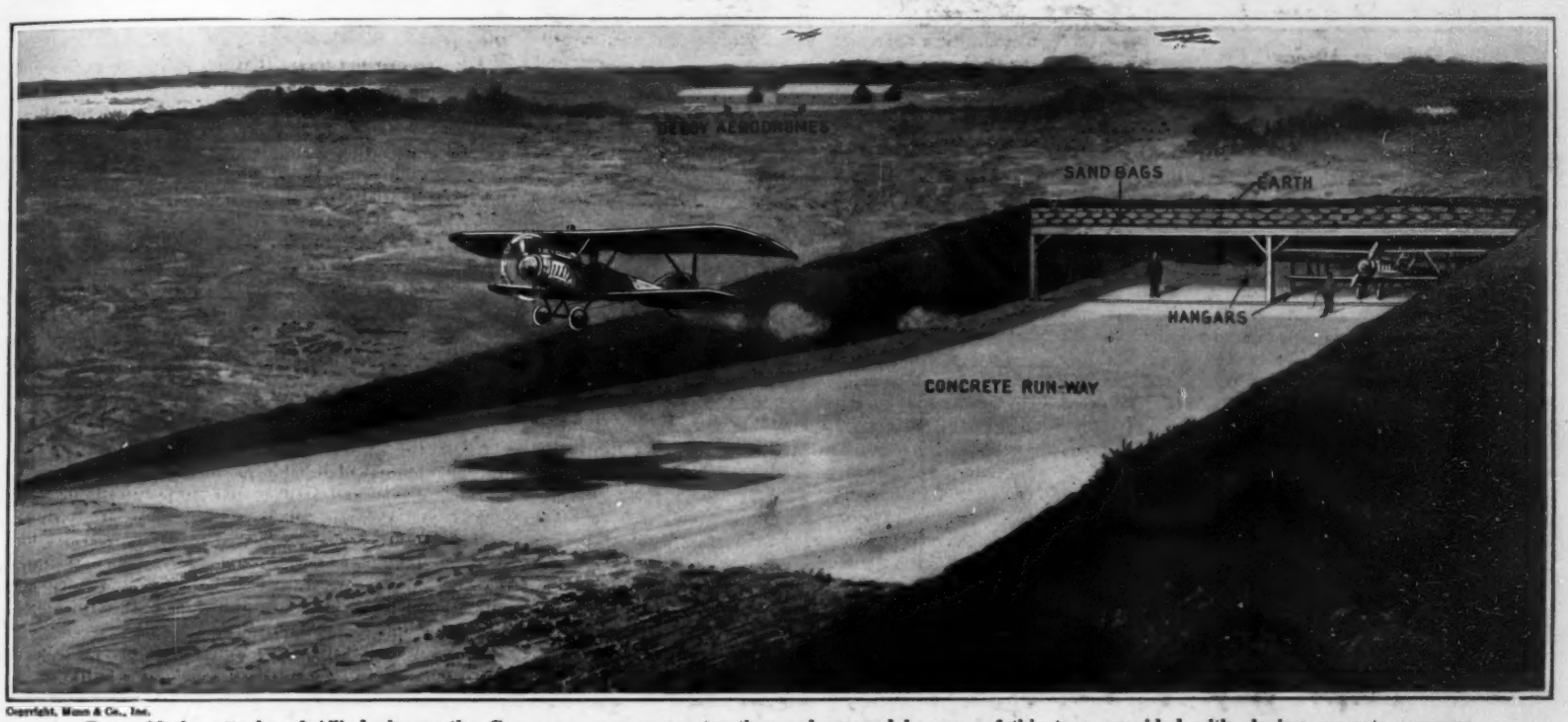
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXVIII.
NUMBER 18

NEW YORK, MAY 4, 1918

[10 CENTS A COPY
$4.00 A YEAR



To avoid the attacks of Allied airmen the Germans are now constructing underground hangars of this type, provided with sloping concrete runways which can be used for starting

Underground Hangars of the German Airmen

THESE are unhappy days for the German flying men. Not only are they confronted by overwhelming numbers when they take to the higher altitudes, but even when resting in their shelters many miles from the battle front they are subjected to the attacks of enemy airmen.

Almost four years of continuous warfare has disclosed the fact that the German is not slow to put new ideas into execution. So it is not surprising to hear that the German airmen have resorted to the same device as their brothers in the first line trenches, namely, underground shelters and hangars as a protection against hostile attacks. It is learned from Allied intelligence officers that at many points on the western front the enemy is busily engaged in building underground hangars and quarters. And this, after all, is nothing more than carrying out their program of wonderful subterranean shelters on a far greater scale than heretofore attempted by the infantry.

From material now available our artist has drawn the accompanying view of a German underground hangar. It appears that the Germans are excavating roomy caves below the surface, which they roof over with a heavy layer of sandbags and the original sod. The roof is supported by pillars at frequent intervals, so arranged as to interfere the least possible with the movement of the airplanes. From the entrance of the underground hangar there extends to the surface an inclined runway of concrete, which can be used most admirably in starting a flight; indeed, no matter what may be the condition of the surrounding terrain due to rain or snow the concrete runway is always ready for service. As likely as not the Germans are using or will use large strips of canvas painted the same color as the surrounding grass, to camouflage the concrete runway and the entrance to the hangar. While speaking of camouflage it is also well to mention that they intend using decoy or dummy aerodromes some distance away from the underground hangars in order to draw off enemy attacks from the real objective.

It would be a case of sheer ignorance to deride this latest German idea, for in many respects it has marked advantages, particularly from the German point of view when the Allied aviators are nightly attacking the German airmen at their camps. Furthermore, it is not infrequent for a severe wind storm to cause considerable damage to the usual aerodrome. Obviously, an underground hangar, if properly built and waterproofed so as to avoid excessive dampness which would certainly prove most harmful to the airplanes and other equipment, ought to be one solution of the housing problem.

Counterfeit Gold Coins Worth More Than Their Face Value

A SHIPPER of platinum from Venezuela recently sent to this country several counterfeit coins which were unusual in that, although counterfeit, they were worth about five times their face or bullion value. They were included in a shipment of crude grain platinum and the consignee, believing that they were gold, as they seemed, carefully removed them from the lot of platinum and sold them to a gold refiner as gold bullion.

Later advices from South America informed him that the coins were platinum, plated with gold, and requested that he have them assayed to determine their real value. The agent hastened to the refiner who admitted that he had had a hard time melting the metal and had himself discovered that it was platinum. Some settlement was made satisfactory to both the refiner and the agent, but the coins were destroyed and no analysis was ever made to determine the exact value of the metal.

In another shipment of grain platinum, received at a later date, the same shipper included a single counterfeit piece. The agent took this to a laboratory for analysis, but intrinsically the single piece was hardly worth the cost of the analysis from the purely commercial viewpoint; besides, the coin being an excellent piece of work in a fine state of preservation, it seemed a pity to destroy it. The gold plating is somewhat worn, disclosing the white metal beneath in spots. It is a counterfeit of an old Spanish piece bearing the date 1789 and the head of Charles IV. It weighs 6.435 grams and has a specific gravity of 18.9. This of course shows that if it is not gold, it must be platinum or at least an alloy consisting principally of platinum. The color of the metal after removing the gold plating, and its hardness, are sufficient additional proof of its character.

It seems that these old Spanish pieces pass current in Venezuela, at least for their bullion gold value. Some unprincipled person in the long ago must have discovered that the native platinum, found to some extent in Venezuela and more plentifully in the neighboring Republic of Colombia, would if melted make a fair substitute for gold in coins, provided the color were properly disguised by a thin gold plating. Whether these counterfeits were made at or near the date they bear or at some much later period is unknown. They are probably a comparatively recent product—but they must have been made some time before our South American friends were able to market platinum at a price above that of gold, and that is long ago. Whenever they were made, we now have the curious condition of a counterfeit gold coin intrinsically worth several times its face value.

Chemistry of Modern Mirrors

PRIMITIVE man used the quiet pool for his mirror and highly polished metal mirrors have been found in most of the ancient ruins. For many generations mirrors have been made of glass, mercury or quicksilver films being the favored substance for the reflecting medium.

The older process is fully described in many places. It was attended by uncertainty and was objectionable for several reasons.

The more modern method is that of depositing metallic silver itself upon the glass, which must be clean if an even, homogeneous film is to be the result. Silver in certain solutions is easily displaced by other substances and being no longer held in solution, it is thrown down upon all available surfaces. The problem is to have it deposited at a rate that may be controlled and in a manner to give a uniform, continuous film free from defects. A large percentage of the silver must be deposited from the solution if losses are to be avoided.

Some recent work at the University of Pittsburgh has shown that alcohol added to the solution increases the efficiency of the process and that sugar is an excellent retarding agent, making it possible to control the rate of deposition.

Formaldehyde is used as the reducing solution.

By the use of these methods it has been estimated that serviceable films can be made at a cost for material not exceeding a few cents per square foot of surface.

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, May 4, 1918

Charles Allen Munn, President, Frederick C. Beach, Secretary, Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Delay in Airplane Production

ABOUT the time of the entrance of the United States into the great European war, a luncheon was tendered to the Editors of a number of prominent journals, under the auspices of the Council of National Defense, at which, for the first time, the plan and scope of the work which had already been partly undertaken was explained at considerable length. The nature of the communication was, of course, confidential. The plans of the Council were very extensive and involved various phases of developing the industrial resources and energies of this great nation. It was at this time that the plan of building up the aviation program was explained in more or less detail, and the underlying idea of the Liberty Motor, which had not been christened at this time, was discussed. The great advantage of producing a standardized type of motor was, however, explained, and approved of by those present.

Unfortunately, in the general press discussion at this time of the part America would play in military aviation, there was much loose talk about our great manufacturing capacity, and the public was led to believe that it would be possible to put one hundred thousand planes on the western front. It is needless to say that these preposterous figures were entirely unofficial; indeed, they were publicly deplored in statements sent out at that time by responsible Governmental authorities.

Unfortunately, statements were made by the Secretary of War, which were extravagant in character and which led our people to believe that, through the efforts of two American engineers, who had been closeted for many consecutive hours in a hotel chamber, an entirely new form of motor had suddenly been evolved, as if by magic, and that our troops would be provided, in a comparatively short space of time, with an enormous number of airplanes of a powerful type. These pretensions on their surface were preposterous and caused many thinking people a distinct feeling of uneasiness. Among our Allies, however, the effect was still more unfortunate. Our Allies believed that we would be in a position to furnish them with a large supply of airplanes in an incredably short space of time.

When the rumors became pronounced that something was wrong with the Liberty Motor, the feeling on the other side was that we had failed to live up to the program as planned. It was, therefore, a great mortification to discover, after one year had elapsed, that not one single machine provided with a Liberty Motor was in actual service in France. This outcome was not entirely unexpected among those who were familiar with the inevitable delays and difficulties of creating a new form of motor for a service with which we were as little acquainted as we were with the art of flying.

When the aviation plans of the Council of National Defense were first explained at the luncheon above alluded to, it was the opinion of our Editorial staff that the proposed plan of committing the United States to a single program for the construction of a new motor suitable to quantity production, was reducing the work to too narrow a field, and that allowance had not been made for the length of time that would be required in designing, testing out and perfecting an entirely new motor in a field which called for superexcellence of materials and workmanship, and imposed the most exacting conditions of service. It was our belief that the program should be carried out in two directions: First, the development of a standardized motor suitable for quantity production; second, the adoption of some plan for copying the best types of existing foreign motors, and their construction in sufficient numbers to enable us to provide training planes for our cadets, and a sufficient number of battle and other planes to equip the American forces that we would be able to place on the western front this Spring. Had this plan been followed out we believe that some months of valuable time would have been saved and that at the present moment, not only would our troops have been provided with American-made planes, but our students would have had opportunities, both here and abroad, of gaining the experience in preliminary training, which they have in so many cases sadly lacked.

It would have been quite possible to carry on the development of the Liberty Motor simultaneously with the construction of a considerable number of the well-proved motor of our own and foreign builders.

In the meantime what was happening in our training camps? It is a notorious fact that for several months they were inadequately provided with training machines. As a consequence the eager spirit of our future airmen has been dampened by their inability to get into the air, and they have experienced the discouragement of inaction. Happily, this matter is being straightened out. On the 1st of April, 3,458 primary training planes had been completed and equipped with Curtiss and Hall-Scot motors. Also four types of advanced training planes are being built, equipped with three types of foreign motors, the Gnome, Le Rhône and Hispano-Suiza, of which about one thousand have been completed. The aggregate capacity of our schools, according to the Senate Committee report, is 3,000 cadets, and about 2,000 have passed the primary courses. Twelve hundred cadets, at the suggestion of the Entente Governments, were sent abroad for training, and machines were promised for this purpose; but owing to the imperative war conditions in Europe, and not through any fault of our department, the men we had sent to the other side found themselves for some months without adequate opportunities for training.

It should be stated that, during October 1917, all administration of aircraft matters was divorced from the Council of National Defense by the creation of the Aircraft Board.

Now with regard to the Liberty Motor and the oft repeated statement that the "motor is a failure" and that "quantity-production has broken down," we take this opportunity to say that both of these statements are absolutely false. It is true that the work of bringing the motor to the stage in which it would be ready for production in quantity, and of providing the machine tools, gages, etc., for quantity production have taken longer than was suggested. Even at that, the time consumed in proportion to the difficulty of the task that has been accomplished, has been remarkably short. The public disappointment has been due to over-sanguine prediction by men who did not know, men who were not familiar with the magnitude of the task.

Speaking from first-hand knowledge after a personal investigation by members of our staff conducted at Washington and at Detroit, we are in a position to say, first, that the Liberty Motor, as it stands today, is a distinct success; secondly, that its production in quantity has commenced and is proceeding at an accelerating rate; thirdly, that these motors, as turned out by quantity-production methods, are standing up to the Government tests, which, by the way, are more severe than those to which the best type of foreign motors are subjected; and lastly, that, not only will our aviation service possess the lightest motor for its power, but a more powerful motor than any other in existence today.

Therefore, we are glad of this opportunity, speaking with first-hand knowledge, to tell the American public that, though the delay, amounting to about three months is greatly to be deplored, the country will witness, from now on, a rate of output of motors and planes, that will go far to compensate for past disappointments.

It is gratifying, moreover, to learn that the necessity for regarding this as a one-man job has been recognized by the appointment of J. B. Ryan of New York and Montana as Chairman of the Aircraft Production Board. Mr. Ryan was formerly the head of the Amalgamated Copper Company and later became President of the Anaconda Copper Company.

An Army of 5,000,000 Men

IN the early months of the war, the Administration was concerned over the fact that the country was slow to awake to the serious nature of the war. Today there is ever-accumulating evidence that the positions are reversed—that the country is getting to be very seriously concerned as to whether the Administration is adequately awake to the serious nature of the war.

In the two years of lamentable inaction that preceded our entrance into the war, the intelligent, patriotic and far-seeing elements of the country succeeded, through the medium of the press, the platform, the parade and the patriotic rally, in so far awakening the great American public, that the people finally succeeded in forcing the Administration to take some measure of preparedness for the safety of the country. Today, after we have been twelve months in the war, it looks as though these elements, combined with the all-but-unanimous voice of the great American people, will have to force the hand of the Government again—this time in the direction of making adequate military preparations for the tremendous crisis which in this very hour faces the Allied cause.

For it is as clear as the noonday sun that the complete collapse of the great armies of Russia, the release of an unsuspectedly numerous and powerful German and Austrian Army from the Russian front, and the disastrous blow which these sudden reinforcements have enabled the enemy to strike, first in Italy and now in France, has so far changed the military situation, that the initiative—the power to attack at will in overwhelming force—has passed from the Allies to the Central Powers and is likely to remain there for a long time to come.

Has the Administration grasped the meaning of this tremendous reversal as to its magnitude and its sinister potentialities for the future?

We hope so; for although the disaster on the Somme front has served to hasten the dispatching of our troops to the front, there is no indication whatsoever that the War Department realizes how completely the balance of military power has been changed, or that this change calls for a practical redoubling of the scale of our preparations for participation in the stupendous fight against the enemy.

For we must not forget that our plans for raising and equipping an army were formulated on the military situation as it stood before the Russian army was eliminated as a factor in the problem, and, that apparently, the Administration is content with its original plans and has made no proportional effort to meet the relatively vastly increased strength of the Central Powers due to the Russian betrayal.

Stirred by events in France, the country at large undoubtedly believes today, and we ourselves are certainly of that opinion, that we ought at once, with a view to the tragic possibilities of disaster in the future, to double the scale of our military preparations, at least in the two particulars of men and artillery. For it was by overwhelming strength in men and artillery that Germany was able to make the irresistible concentrations which broke the Allied line first on the Somme and then in Flanders.

If, as the Allies, always gloriously optimistic, assure us, their lines will be able to hold, Germany with her surplus of men and artillery has simply to dig in where she is, and the war will resume its old and wearisome condition of entrenched deadlock. If the German line is to be broken, *and the breach is to be kept open*, the thing can be done only by a vast superiority in men and munitionment. The means to create this superiority can come only from America.

The question arises then, does the present scale of our preparations guarantee any such superiority.

We answer emphatically "no".

We believe that, to attain such superiority our preparations must be on the scale advocated by a former ex-Secretary of War and ex-President, William H. Taft. In place of an army of 2,000,000 which is partly trained or in course of preparation, we should have an army of not less than 5,000,000. The transport of this larger army will be solved by the advent upon the seas of the huge fleet which we now have under construction.

But how shall this be done? It can be done by the Administration translating the practical effort of practical men, chosen absolutely irrespective of their political affiliations, and working on a well-ordered plan designed to secure this very result. We have sixteen cantonments for the training of drafted men, which were built in four months' time. Being now possessed of the plans and experience we could, if the Administration would, find ourselves possessed of another sixteen cantonments by the middle of the summer. The cantonments, barracks, training grounds, etc., for the regular Army and National Guard could be doubled within the same period.

As to artillery, we have always regarded with dismay the statement of the Allies that they were prepared to furnish all the artillery that our troops could use; for we have felt certain in our heart of hearts that this prediction was based upon the sure knowledge that only a limited number of American troops would be available during the coming months. For it is certain that if the Administration rises to the full height of its responsibility, and listens to the clear call of facts as stated by a country which is now awake to the facts, and makes provision for an army of 5,000,000 men—we shall need every gun, big and little, that the manufacturing capacity of these United States of ours can supply.

The Secretary of War, on his return from France, told us that the spirit of the boys in the trenches was magnificent. The people of the United States did not need to be told that—they knew it already. They would have been better pleased if our Secretary had told them that, should the exigencies of this war of the nations demand it, there would be two million of our soldiers in the trenches and back of the trenches this year, an additional two million next year, and a total of five million men on the European battle field in the year 1920.

But how shall they be carried there? As the successive armies are made ready for the front, the enormous shipbuilding facilities of the United States will provide the ships. Work in the past year has been preparatory. Henceforth, ships will be launched at a steadily-accelerating rate.

Electricity

Friction Tape should never be wrapped directly upon bare copper, said *Electrical Review* recently, without an underlying layer of rubber or some other form of protecting fabric. Friction tape has a greater tendency to dry out when wrapped on itself and a fairly air-tight and solid joint is difficult to make. Such a joint instead tends to work loose and has low insulating properties. However, more important still, most friction tapes contain chemicals such as sulfur, which, when in direct contact with copper will attack it chemically, causing corrosion. This weakens the insulating covering and will reduce the copper cross-section, and thereby reduce the conductivity and mechanical strength of the conductor.

Photoelectric Sensitivity of Various Substances.—Writing recently in the Journal of the Washington Academy of Science, W. W. Coblentz and W. D. Emerson summarize results on an investigation of various substances to determine the increase in electrical conductivity caused by the action of light upon them and for electrical discharging activity when they were charged to a negative potential in an evacuated chamber and exposed to light. Selenium, stignite, boulangerite, jamesonite and silver sulfite show an increase in electrical conductivity on exposure to light. Pure gallium and silver sulfite were found to have only a small photoelectric discharging action when charged to a negative potential and exposed to light. The electrical conductivity of tellurium, bolelite, bismuthinite and mixtures of the sulfite of lead and antimony were not changed on exposure to light.

Improved Insulated Pliers.—Heretofore the average insulated plier offered to the electrical and hardware trade has been of hard rubber stock, which is obviously not practical for rough usage. Now comes a new type of electrician's plier which will not only give the hard, practical service the lineman requires, but which has an insulating compound of such a character that it is semi-soft, not hard. Therefore, the insulation will not crack or break when dropped or struck on a hard surface. It is claimed that the bond of uniting the rubber compound to metal makes a permanent attachment, and is in no way to be confused with the present slip-on handles of semi-soft rubber and the methods of attachment to the handles of insulated pliers which are neither practical nor can withstand a test for dielectric strength after hard impact. Every pair of the new pliers is subjected to a 10,000-volt insulation test.

Electrical Heating for Beds.—In view of the great importance of a warm bed, especially in pneumonia, "it is more than a little curious," says the *Lancet*, "that the maintenance of the patient's warmth in bed should have been left so long to the precarious ministry of the hot-water bottle." It is true that electrical devices have been introduced for this purpose, but they have not come into general use. The *Lancet* tells us how this problem has been solved at the Treloar Cripples' Hospital, Alton, England, where two wards are now supplied with electric mattresses, which have proved both safe and convenient. The mattress looks like any other, except that a flexible wire enters it at the head. The resistance wire is insulated by glass beads in flexible metallic tubing incorporated in the substance of the mattress. The heating element is so arranged that the maximum heat is produced at the foot end, less in the middle, and none at the head. The current may be graduated by a switchboard on the wall, so that any desired degree of heating may be produced up to a certain safe maximum, which cannot be exceeded. It is found that the use of this device results in a saving of three hours a day in each ward where the electric mattress has replaced the hot-water bottle, and the expense is not excessive.

Wireless and the Germans.—From various sources it is gathered that Government agents have discovered certain German agents making use of wireless equipment in the New England section of our country. According to one report, these alien enemies make use of indoor aerials, while another hints at the use of aerials in wooded localities and connected with the operators some distance away by means of discarded or little used telephone wires. All of which is quite plausible as far as receiving wireless messages is concerned. However, when it comes to transmitting wireless messages, the chances are that either of these systems would be of little value. It requires only a small aerial to receive signals from the powerful German stations, provided the best of apparatus is available, and this fact was mentioned in these columns when our country first went to war. Indeed, it would seem almost impossible to prevent the enemies in our midst from receiving messages from abroad because of the ease with which an aerial can be concealed, save by a house-to-house search. But as concerns the transmission of messages to tramp steamers or U-boats operating somewhere off our shores, the size and efficiency of the aerial required must needs lead to detection in short order. And it is the transmission rather than the reception of intelligence that constitutes the greatest menace to us.

Science

Commercial Aviation in Norway.—According to a consular report a meeting of Norwegian business men, held at Christiania March 1st, took the initial steps toward the organization of a company which is to maintain an aerial transportation service for freight and passengers between various places in Norway and also between Norway and other countries. Hydroplanes of the latest models are to be used. One route is to skirt the Norwegian coast, connecting Christiania, Christiansand, Stavanger, Bergen, Trondhjem and Kirkenes. There will also be cross-country routes between Christiania, Trondhjem and Bergen. Finally, it is hoped to maintain regular service between Stavanger and Aberdeen (Scotland), and between Christiania and Copenhagen.

How Fast Can Fish Swim? Few observations have been published on this subject, according to a recent paper by Mr. Emerson Stringham, though the question is of economic importance in connection with the effect of waterpower development on the fisheries. A Belgian authority, G. Denil, while studying fishways, concluded that salmon could swim at a speed of 3.15 meters a second for at least 14 meters. A Canadian, G. P. Napier, from investigations in the Frazer River, expressed the opinion that the limiting velocity of a steady stream up which a sockeye salmon could swim a very short distance was between six and seven miles an hour. Finally, Mr. H. von Bayer, of the U. S. Bureau of Fisheries, declared that the velocity of the current in fishways should not exceed 10 feet a second. These various figures, arrived at independently, are substantially in agreement. From his own studies on fishways in Massachusetts, Mr. Stringham found that a common species of alewife could swim for at least a few feet through water flowing about 10 feet a second, about the limit for fishways.

An Indication of Fecundity in Fowls.—Dr. A. F. Blakeslee, in his investigations at Cold Spring Harbor, L. I., discovered a few years ago that yellow pigment on the ear-lobes and shanks of White Leghorn fowls is inversely correlated with fecundity. His further researches on this subject show that the percentage of yellow in the ear-lobe during October is closely correlated, inversely, with the mean annual egg-production. This discovery is of practical interest, since by it one can tell in October without trap-nesting which birds have been the heaviest layers during the past year. Birds showing only 10 or 20 per cent of yellow in their ear-lobes will have laid at the end of the year, on an average, about 185 eggs; those exhibiting 55 or 65 per cent yellow will have laid on the average only about 130 eggs. The result is believed to be due to the circumstance that the growth of the eggs in the ovary abstracts yellow pigment from the body-tissue, or prevents it from being deposited there. The measurements of color are made with the color top (a top provided with color disks, for blending colors in any desired proportion).

The Exploration of the Mediterranean.—The war has hampered but has not altogether suspended the systematic exploration of the Mediterranean which has been in progress for some years under the auspices of certain official and quasi-official organizations in the countries bordering that sea. The most important organization now at work is the Royal Italian Thalassographic Committee (Regio Comitato talassografico italiano). This body, which grew out of an unofficial commission organized in 1883, became a government institution in 1910 and was enlarged to its present important scope by a law of June 5th, 1913. It has its official headquarters at Genoa, but holds annual meetings in various cities of Italy in conjunction with the Italian Association for the Advancement of Science. There are branches or sections at Genoa, Venice, Naples and Messina. The scientific work of the committee covers a wide range of subjects, including biology, fisheries, chemistry, physics, tides, meteorology, etc. Particularly interesting, as indicative of the up-to-date outlook of this organization, is the fact that a large amount of the committee's attention has been bestowed upon the study of the upper air for the benefit of aviation. Observations of the winds are made regularly with pilot-balloons at 30 stations and the results are telegraphed to Rome, where they are published in the form of a daily bulletin. Down to the summer of 1914 the committee carried out an elaborate series of oceanographic surveys in the Adriatic, in coöperation with the Austro-Hungarian government. As but little is known about the tides of the Mediterranean (often erroneously described as a tideless sea), the committee has installed a series of mareographic stations, 17 in number, on the coasts of Italy, Sicily and Sardinia. In December, 1916, the committee founded a biological station, one of the finest in the world, at Messina. Spanish oceanographers are also carrying on their researches in spite of the war; especially in the straits of Gibraltar, where the surveying vessel "Nuñez de Balboa" continues its work. Just before the war began an international commission for the exploration of the Mediterranean, with representatives from seven countries, was in course of organization, and was to have had its headquarters at Monaco.

Automobile

The Brake Problem.—A correspondent, commenting on a recent note in these columns bearing the annexed title calls attention to the fact that skidding may be caused by too high speed, wet pavements, badly adjusted brake bands and an attempt to suddenly change the direction of the car. These points are undoubtedly true, and the statement in the note in question in regard to skidding was, critically considered, rather broad; still, the principal purpose of that note was to call attention to the fact that the automobile brake and its operating mechanism is susceptible of very considerable improvement, and that very little has been done in this direction of late years.

Sham Good Roads.—Many people have appreciated that there is altogether too much sham in our road building, and that in too many cases they are only thin veneers, good enough for the fair-weather joy rider, but with no substantial permanence. The incidents of the past winter, which suddenly threw a considerable traffic of heavy trucks onto these roads, foreshadows a serious condition of affairs next year, for, with a heavy season's use by motor trucks, with a shortage of labor available for repairs, there is grave danger that many miles of much needed roads will be in no condition to withstand the traffic we have every reason to expect next winter; and by another summer there may be no roads left. There has been but little real road building in this country, and it is time more thorough methods were adopted.

Tire Costs Reduced.—A leading tire manufacturer has an interesting story to tell about tire costs that is very pertinent in view of present conditions. In 1913, taking one type of tire as a standard, the user got from 3,000 to 4,000 miles service, which cost him about one cent a mile for each wheel. In 1914 improvements increased the mileage to 4,000-4,500, and this, with a decrease in the price of the tire, brought the cost to 65/100. In 1915 there was a further decrease in price, and the average mileage increased about 500, making the mileage cost about 48/100 of a cent. In 1916 the cost of materials began to soar, but improved manufacturing methods brought the mileage up to about 6,000 miles, which, in spite of higher prices, gave a mileage cost of about 45/100 cent. During the past year the cost of materials has been sky-rocketing, but by reason of further improvements it is expected that a mileage of from 7,000 to 8,000 will be shown, giving an actual probable cost of 5/100 of a cent per mile. These figures are based on what a careful, intelligent driver ought to get, and can get by proper care of his tires.

Preserving Our Roads.—Our method of building roads in the past has been to spread all the money available over as many miles as possible, and the result has been long stretches of very lightly constructed roads, of decidedly limited durability, with nothing left with which to maintain them. Any repairs that might be made were entirely superficial, and the usual custom has been to wait until the road was worn out, when there would be another good big job for the politicians to manipulate. Of course most road engineers have begged for deeper and more substantial foundations, which would make for greatly increased permanency, and reduced repair costs, but, as this part of the work is out of sight, the demands of the engineers have generally been scandalously disregarded. But it is hard to understand why these engineers have had so little to say about maintenance systems. In Europe it is fully recognized that to preserve a road in efficient condition requires constant and prompt repairs, but it looks as if we would squander many more millions before we learn to build properly and to maintain intelligently.

Tests by Experts.—When a new design is evolved it is customary to subject a trial car to what is supposed to be exhaustive tests under all sorts of conditions before putting it on the market, and yet, in more than one instance, a very promising model has had to be withdrawn soon after coming into the hands of the public on account of unexpected failures. The cost of the trials is great, but not to be compared with the loss incurred in large stocks of parts, and sales losses, all of which might have been saved by a different system of testing. The usual test is made by factory drivers, experts, who absolutely fail to give the car the kind of treatment that it must stand at the hands of the buying public. The factory man knows too much about the insides of the car, and instinctively favors it accordingly. He, in the same way eases the car over bumps; he knows just when and how to change gears, and he is guiltless of that kind of jerky clutch work that racks the entire car so seriously; and as a result, the weak points of the design, that could have been easily corrected if known in time, are undiscovered until the car gets its real test in the hands of the public. The moral is to secure the services of genuine amateurs to make the tests, and to have these tests repeated by a number of different drivers of this class. It is a brutal process, but thorough, and economical in the end.

Flowers That Fertilize Themselves

Some Notable Exceptions to Nature's General Principle of Cross-Breeding

By Albert A. Hansen

A FREQUENT statement in biological work is that cross fertilization is almost essential in order to prevent weakening and consequent deterioration of the species. Such a statement, however, is not always verified by facts. Many of our cultivated plants have long been vegetatively propagated; thereby the effects of fertilization are eliminated with no apparent degeneration or deterioration. Also there are several plant species which are habitually parthenogenetic, particularly the hawkweeds, *Hieracium* sp., and the dandelions, *Taraxacum*, sp., and have apparently retained all of their vigor, even though fertilization has ceased altogether. Some of our finest animal breeds, as for instance, the Royal Coach Horses of Austria, have been maintained by close inbreeding.

Perhaps the greatest stumbling block to those who argue for the necessity of cross-pollination is presented by the plant phenomenon termed cleistogamy. Many plants produce flowers which never open; hence, self-fertilization is necessary. Such flowers are known as cleistogamous flowers. In fact, instances have been reported, as in the sage, *Salvia cleistogama*, where dependence for reproduction is placed entirely in these self-fertilizing flowers. Often where plants produce both the ordinary and the cleistogamic flowers, the latter are by far the more productive, as is well illustrated in the Wonderful Violet, *Viola mirabilis*. The derivation of the word from the Greek *cleistos*, closed, and *gamos*—marriage, is very suggestive.

Some of the facts concerning this type of self-fertilization are extremely interesting. Cleistogamous flowers are usually smaller than the normal ones, and practically always show either entire abortion or much stunted development of the petals. Since the petals are normally useful for the attraction of insects, the reason for their suppression in cleistogamous flowers is obvious.

Another characteristic of cleistogamy is the reduction in the number of pollen grains produced by each flower. Thus in Cut Grass, *Leersia oryzoides*, about fifty pollen grains are produced in each cleistogamous flower, as compared with over three million counted in the normal flower of the Peony. Since insect pollination is wasteful, the reason for the reduction of the number of pollen grains in cleistogamous flowers is apparent. Even the number of stamens may be reduced, as is illustrated in the Rockrose, *Helianthemum canadense*, a plant possessing both normal and cleistogamous flowers. In the former, the stamens are normally indefinitely numerous whereas in the latter they have been reduced to from three to ten.

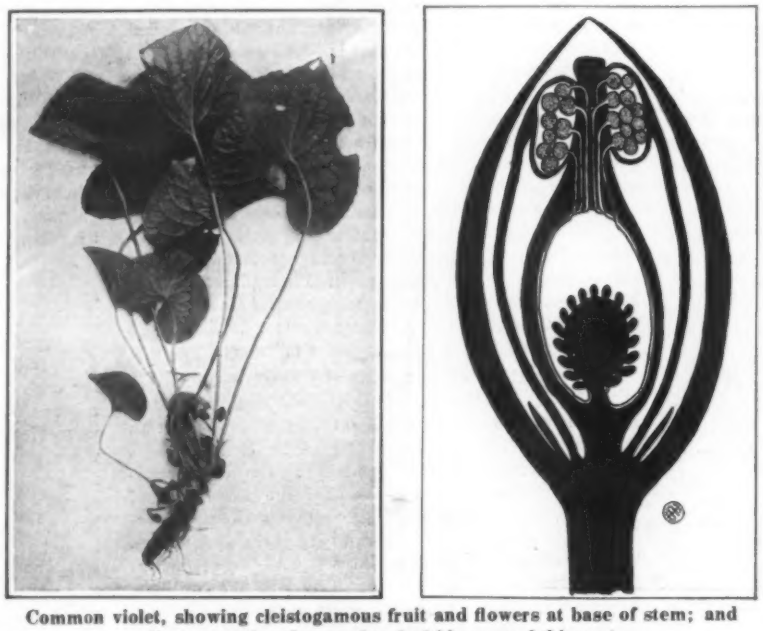
Another phenomenon presented by cleistogamy is the frequent production of functioning pollen tubes from pollen grains which never leave the anthers, the latter remaining closed. This is further facilitated by weakened spots in the wall of the anther, frequently illustrated in violets, through which the pollen tube penetrates. The close association of the anthers and the stigmas in these unopened flowers readily explains the cause of this interesting phenomenon.

Many forms of cleistogamous flowers are subterranean, as is illustrated in species of violets, Bitter Cress, *Cardamine chenopodifolia*, and the Milkwort, *Polygala polygama*. The advantages of such a situation are many. The seeds are practically planted on maturity, with little loss from the depredations of seed-eating animals. The pollen is also well protected from pollen-eating insects and from the loss occasioned by wind and rain.

The conditions leading to cleistogamy are many and varied. On the Balsams, *Impatiens* sp., the presence of a fungus has induced cleistogamy and the same effect has been observed on *Biscutella* when attacked by certain parasitic insects. Nutrition seems to be another factor, as indicated by the fact that the Touch-me-not, *Impatiens noli-tangere*, which ordinarily produces both open and closed flowers, will produce only the latter when the plant is transferred to a habitat affording but poor nutrition, as for instance in sand.

The sun also exerts its influence. Certain species of violets when grown in the shade will produce only cleistogamous flowers, but when transferred to a sunny environment will produce petaloid flowers in abundance.

Perhaps the strongest factor to influence cleistogamy, however, is temperature. A cool temperature seems to induce the production of the self-fertilizing type of flower, whereas a warmer temperature seems to influence the forming of the petaloid flowers. Thus species which are ordinarily cleistogamous in England become normally of the open-flowered type in Italy. The temperature factor is well suggested in the Dead Nettle, *Lamium amplexicaule*, which is cleistogamous during the cool spring and autumn, but which becomes chasmogamous (of the petaloid flower type) during summer.

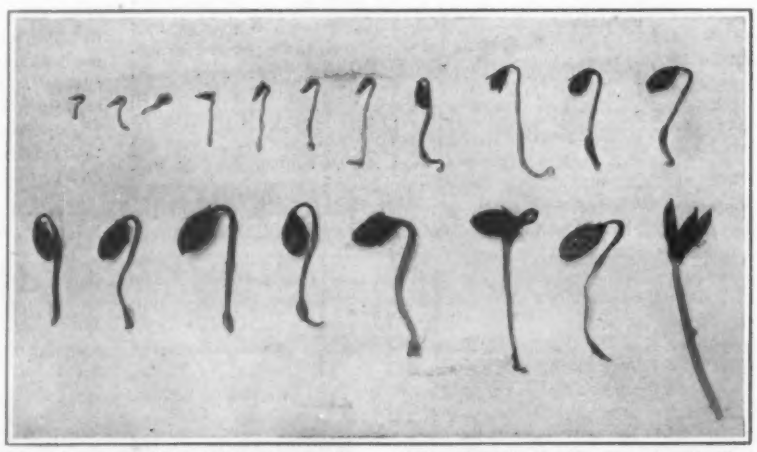


Common violet, showing cleistogamous fruit and flowers at base of stem; and diagrammatic scheme of typical blossom of this sort

The close relationship of the stamens with the stigma causes lack of pollination, since the pollen tubes simply penetrate the walls of the anther. The style is somewhat aborted. At the base of the stamens the rudimentary petals may be seen.

A situation similar to cleistogamy is presented by many species, particularly in flowers of mountain habitat, when continuous rainfall during the period of floral maturity drives away the pollinating insects. Such flowers frequently fail even to open under such conditions but successfully mature seed through the agency of self-fertilization.

A wider knowledge of the facts related to cleistogamy may possibly have influence on experimental genetics. The phenomenon at least suggests that the necessity of cross-pollination has in past been too strongly emphasized. In the light of our present knowledge it may be stated that for some plants and animals cross-fertilization is beneficial, while for others self-fertilization is preferable.



Development of the cleistogamous flower of the violet into a large seed pod with perfect seeds. The flower remains entirely closed throughout this process

New Dutch Export Industry

By I. I. Brants

AS is known, all meteorological stations daily use large numbers of small balloons for determining the direction of air currents in the higher atmospheres. These balloons are about four inches in diameter and when inflated with hydrogen gas expand to about twenty-four inches. Their extremely elastic envelope allows the gas to distend as the surrounding atmosphere becomes rarer, until in the end the rubber bursts. This gradual distending causes the balloons to rise with a uniform velocity of about 450 feet a minute. They float on the prevalent air currents and are watched for this purpose through a telescope. When in the upper layers of the atmosphere the winds are strong the balloons soon disappear from view, otherwise they take a considerable time before apparently descending to the horizon. The best conditions for meteorological observations obtain when the winds in the lower and in the higher layers run in opposite directions. Then the balloons on passing from the one into the other return the way they have come and pass close to the zenith over the observer's head.

When the war broke out the exportation of rubber from Germany came to a sudden standstill, and the Dutch Institute was no longer able to supply themselves there. During the first years of the war it was still possible to obtain these balloons from France, but, in the autumn of 1916 the French Government likewise forbade exportation. Till the beginning of 1917, therefore, observatories had to be stopped. At that time a Dutch factory succeeded in producing the first balloons really satisfying reasonable demands. This factory has continued producing them with ever-increasing success and in ever greater numbers so as now to be able to work for exportation. A year's experience of the Dutch balloons has convinced the Institute at De Bilt, near Utrecht, of their great superiority over the German or French make. For one thing their visibility is greater, as they are pure white and when inflated become as clear and transparent as glass, consequently remaining to the very last visible through the telescope. This is not the case with the dirty gray German and French balloons, which in the air soon assume a yellowish auburn hue. The Dutch balloons on clear days are like huge soap bubbles distinctly marked against a blue or even milk-white background. Then, too, they contain between ten and fifteen times as much gas as those of German make.

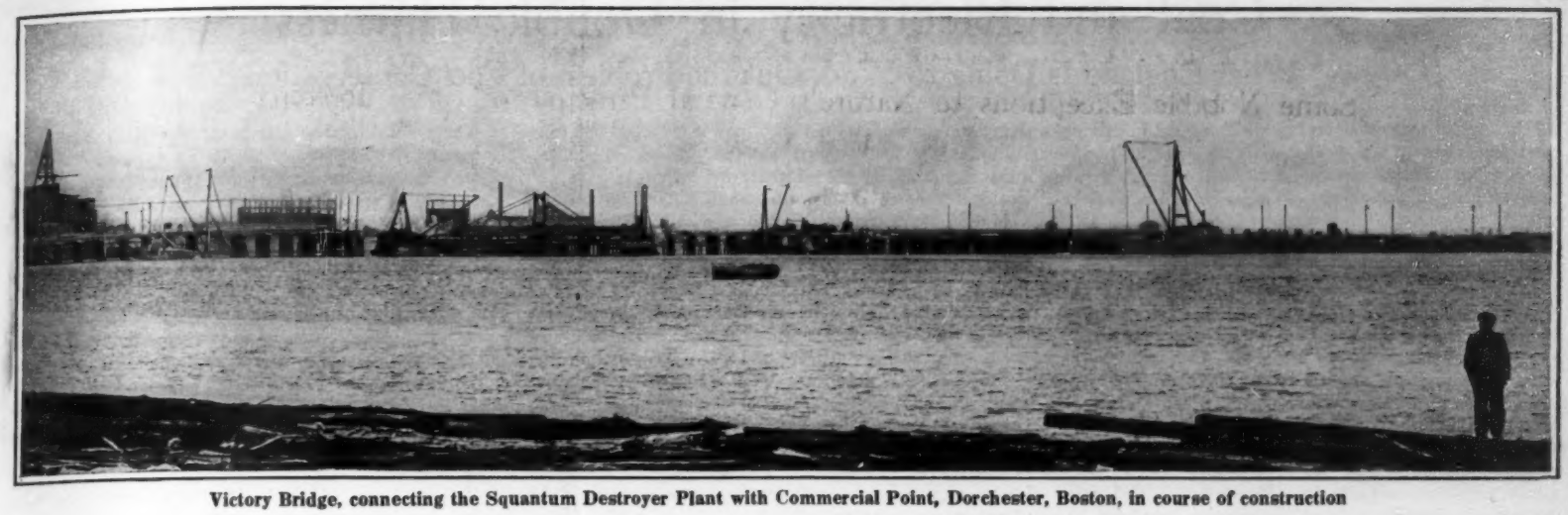
Owing to their visibility Dutch balloons can usually be followed under Dutch atmospherical conditions to a height of seven miles, frequently to 10½ miles. Because of their great elasticity and inflatability it is not known at what height they habitually burst. All that has been ascertained is that a balloon of not quite six inches diameter made of rubber of 0.00788 inch thickness and inflated to a diameter of over twenty-two inches does not burst below an elevation of 10½ miles. Its surface at that height must have reached fifty times its initial dimensions, its diameter must have been 40 inches, and the thickness of the rubber sides not more than 0.0001576 inch. The importance of this latter figure will be realized, when it is remembered that hitherto a thickness of 0.000788 inch was supposed to be the minimum immediately preceding bursting.

These most satisfying results have encouraged the factory to try turning out much larger balloons able to carry meteorological instruments. The Dutch Institute had just begun these experiments with German balloons when the war broke out and they had to be discontinued for lack of suitable materials. In 1917 experiments made with balloons of 100 cubic meters composed of varnished paper failed.

These Dutch balloons are made by dipping glass balls into rubber disolved in benzine. On withdrawing these from the bath a thin coating of the mixture clings to them. As the benzine evaporates the rubber remains. This process is repeated several times until the rubber coating has acquired sufficient thickness. It is then vulcanized and stripped off its ball.

Aurora Australis

A REMARKABLE display of aurora australis was observed throughout Australia during the night of August 9th-10th, 1917. The brilliant red color of the display is said to have led to the fire brigade being turned out to extinguish a supposed conflagration. The operation of telegraph lines was disturbed by earth currents.



Victory Bridge, connecting the Squantum Destroyer Plant with Commercial Point, Dorchester, Boston, in course of construction

Building a Bridge in Six Weeks to Save a Half Hour

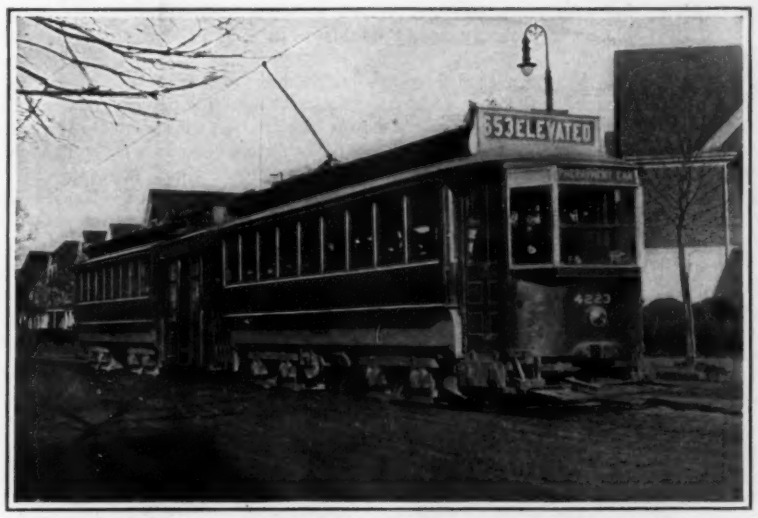
NOTHING is too costly or impossible in carrying out our war program. That is the impression one gets when traveling through any section of this big country during these days of preparation and toil for the struggle across the sea.

A typical case is that of the Squantum Destroyer Plant near Boston, Mass., which is popularly known as the Victory Plant in that locality. One of the chief difficulties in locating the plant on the Quincy side of the Neponset River was the inaccessibility to Boston and the lost time and inconvenience of laborers and mechanics in getting to work.

Something had to be done—and done in a hurry.

So it was decided to run a bridge directly from the Squantum plant to the nearest point, which is known as Commercial Point, Dorchester. As time was the paramount element, the type of construction decided upon was the usual wood pile construction, and as the bridge crosses a navigable river, a draw had to be installed which was, of course, of steel. Work was started late in October, under the direction of Thomas C. Atwood, Supervising Engineer for the Bureau of Yards and Docks. The bridge was completed shortly after the middle of December, so that by Christmas all laborers to and from the plant were furnished a direct route 20 minutes from the elevated terminal in Boston, thus doing away with approximately two and a half miles of distance to be traveled and one-half hour's time for each trip; furthermore, and this is an important consideration where workmen are concerned, the extra carfare called for by the second street railway company has been eliminated. Fortunately, the greater part of the work was completed before the ice reached sufficient thickness to cause trouble.

The Victory Bridge, as it is called, was first used for passenger traffic only in the rush hours morning and evening; but at the present time a half-hourly schedule is in effect continually through the day as well as extra service morning and evening. Besides caring for street traffic, the bridge is used for pedestrians and for the teaming of materials to the Squantum works.



A novel use for worn-out street cars: Train made up of two cars and known as the "snake car"

Boston's Snake Cars

TAKE two old street cars no longer fit for further service, join them together using a hanging vestibule body as the coupling, rearrange the wiring and air-brake connections, and in this manner secure a train-like car with great capacity and fairly smooth running properties because of its weight. That, in brief, is Boston's formula for rehabilitating worn-out street cars. The scheme was tried out some three years ago, and after a long test it seems that it is entirely practical.

In the accompanying illustration appears a typical double car or "snake car" as it is popularly known in Boston. The cars going to make the train are joined together by means of a vestibule member which rides on the coupling, and which is connected to each car by adjustable corridors that expand or contract when the car turns in either direction. The adjustable corridors have sides consisting of strips of heavy material, wound on spring-operated rollers which pay out or take up as circumstances dictate. The snake car is of the pay-as-you-enter type, and the conductor is stationed in the middle section where he can manipulate the pneumatically-operated doors for passengers getting on or off.

All four motors of the snake car are controlled from the controller at either end, while the same applies to the air brakes. However, in the case of the latter only one pumping unit is employed.

The Gasoline Engine Turns Street Sweeper

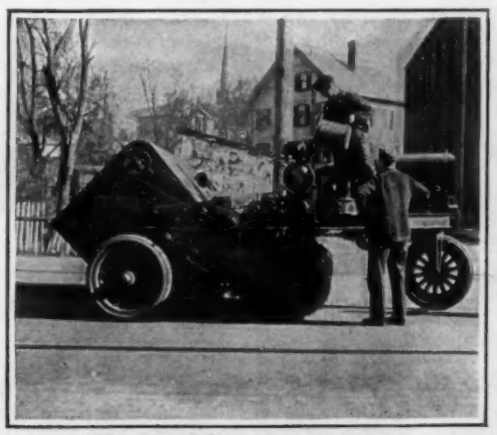
AFTER numerous attempts marked with more or less success, the gasoline engine has at last established itself firmly in the ranks of the "white wings" or street cleaners. That is to say, there is being employed, at present, a practical type of gasoline-driven street sweeper in many of our towns, with a considerable saving in labor and time.

What may be considered a practical street sweeper is in the form of a three-wheeled gasoline-driven vehicle. It is claimed that this machine does the work of four horse-drawn sweepers, and cleans the streets at a cost of seven cents per thousand yards, including the upkeep charge. An 80-gallon water tank under a 60-pound pressure serves to provide a powerful stream of water to four nozzles in front of the machine. The water is forced out in a fine spray, wetting down the dust so that it can be picked up by a revolving brush eight feet wide, and carried by a conveyor to the large container in front. The container, which is provided with a hinged top, has a capacity equal to that of two ordinary dirt wagons.

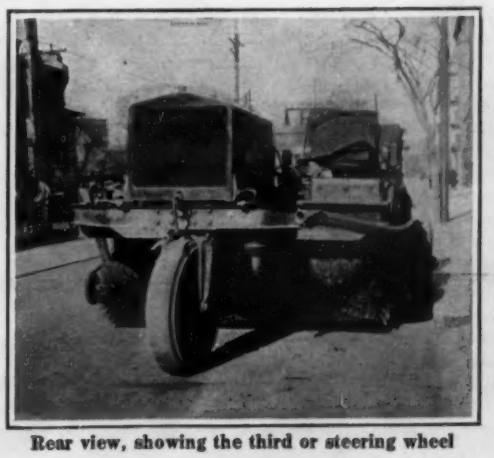
This gasoline-driven street sweeper does the work of four horse-drawn sweepers

The propulsive power for the street sweeper is supplied by a 40-horse-power engine located in a hood at the rear. Connected to this engine is an air pump which produces the pressure for the water tank, while a chain-and-sprocket drive revolves the large brush and the conveyor arrangement. Two speeds are provided with forward and reverse drive, and the vehicle is said to develop a speed of 10 miles an hour. It cleans the street pavement to within 16 inches of the curb, that part being left to the street gang.

It is reported by communities which have tried the new sweeper that it is far superior to the hydraulic flushers.



Side view of the new street sweeper



Rear view, showing the third or steering wheel

Coal and Electricity in Double Harness

What England Is Doing to Work Out the Problem of Fuel Conservation

THE actual amount of energy which we get in driving-power from a ton of coal with the most up-to-date methods of combustion and utilization of heat or gas is a very small percentage of what is obtainable theoretically.

Eminent scientists have suggested that we should convert our coal into gas at the pit-mouth and convey it thence by pipe-line to wherever it may be required. This would, no doubt, save an immense amount of transportation and handling of coal, with the accompanying expense and loss; but we have yet to learn whether questions of pressure and other conditions connected with coal-gas would permit of its being practicable, safe and commercially profitable for long distances and wide areas. It seems more likely that the conversion of coal into electric current in close proximity to the mine would yield better results, a more flexible and safer method of transmission and distribution for long distances, and more useful forms of power, warmth and illumination than those obtainable from the combustion of gas.

In this connection, the interim report recently made to the Ministry of Reconstruction in Great Britain by the Coal Conservation Sub-Committee, and made public by Dr. Addison, is full of suggestion and significance as indicating one of the various lines along which both America and England may travel toward victory in the war after the war—the struggle to make good the losses suffered by the militant nations, to pay off the accumulated national debts incurred and to checkmate the attempts of the Central Powers under Germany's hegemony to capture the world's trade, for which they are known to have made formidable preparations. Both the great English-speaking peoples and their Allies will need to mobilize the national resources in peace, as they have done in war, and the conservation and right utilization of their coal and by-products of its combustion rank high in importance in this respect.

The British Sub-Committee proposes to supply all industries with electrical power generated at large "super-power stations"—not more than sixteen in number for the whole country—and to eliminate or combine all smaller stations.

The primary object of the scheme is to economize the coal supplies. The amount of coal used in the United Kingdom for the production of power is 80,000,000 tons, at a cost of say, £40,000,000 at the pithead. The Committee confidently states that, by an up-to-date and national scheme of electrification, 53,000,000 tons of this (£27,000,000 a year) could be saved. This, with a saving of the by-products now wasted by the burning of coal in open grates and boiler furnaces, would effect a national economy of £100,000,000 a year. The most economical way of obtaining power from coal on a large scale is by generating electricity from it. The coal now used, says the Committee, would, if used economically, produce at least three times the present amount of power. An increased use of power is of the highest importance to the future prosperity of the country. It is the best way to increase the net output per head, and therefore the prosperity of the worker. "The best cure for low wages is more motive power." In the United States the amount of power used per worker is half as much again as in the United Kingdom. Leaving out of consideration workers in trades where the use of power is small, or even impossible, it is probably nearly double what it is in Great Britain.

It has been settled conclusively during the past 15 years that the most economical means of applying power to industry is the electric motor. In the factories put down for the production of munitions during the war 95 per cent of the machinery is driven by electricity, and it is only a question of time for all power to be applied in this way. The problem is not how to apply electric power but how best to generate it. The development of electricity has been hindered by the multiplicity and the smallness of the electrical undertakings. At the present time the supply of electricity in Great Britain is split up among about 600 companies and municipal undertakings. The average generating capacity of such of these undertakings as possess power stations is only 5,000 horse-power, or about one-fourth of the capacity of one single generating machine of economical size, and about one-thirtieth of that of a power station of economical size. Technically and commercially the big generating station is admittedly the best. The reform proposed by the Committee is to supersede all these small undertakings by laying down throughout Great Britain main trunk lines to be fed by some sixteen "super-power stations."

The generating machines in these stations should be of large size, not less than 20,000 horse-power each. In more important industrial districts machines of as much as 50,000 horse-power might be used with even greater advantage. The generating stations should be on large sites, with ample coal and water transport facilities. It is contemplated that at each generating station by-products be extracted from the coal before it is used for the production of power, and that various electro-chemical processes essential to British industry be carried on near by. The sites for the stations must be outside, not inside, towns. This would improve the health of the great industrial centers by the reduction of smoke, and would relieve the congestion of the railway lines in their neighborhood by practically abolishing the carriage of coal.

Various forms of electricity-supply authority, both public and private, are considered, but the Committee, on the whole, favors private enterprise. They are "impressed with the special need for initiative and resource in the management of the business of power supply," and they are of opinion that "the freedom of range and keenness which are distinctive of private enterprise will be found to be in a high degree conducive to the fullest measure of success."

The sixteen great power authorities, whether private companies or public bodies, would be controlled by a National Board of Electricity Commissioners. Existing plants would be handed over on equitable terms to the new authorities. In addition to the main generating stations subsidiary generating plants would be set up wherever there was surplus gas or waste heat, as at blast furnaces and coke ovens, and the electricity so generated would be fed into the main trunk system. In the same way, waste coal, which is not at present worth the cost of carriage, and is, therefore, left at the pits, could be used on the spot.

There already exists in England a practical example of centralized production of electricity for a large area. The northeast coast district, rather larger in area than Lancashire, is served by a group of power companies from one interconnected electrical system. The population of this area is less than that of Lancashire, and the area is, therefore, less advantageous for electrical supply.

(Concluded on page 418)

The Pneumatic Water Works

Pushing Water Up-Hill Before a Head of Compressed Air

OUR scientists and engineers continue to increase the number and variety of uses to which compressed air is put in our industrial and domestic life. We have been brought to employ it as the motive power of the industrial locomotive and of the torpedo; it sets the brakes on our railroad trains, it cushions the weight of our automobiles; it drives the riveting hammer on our great steel structures; it makes modern tunnelling possible, alike by providing the power for our rock drills and by holding back the water from flowing into the excavation which it has been instrumental in forming.

For many years we have pumped water from great depths by sending down compressed air, which in rising again through the return pipe pushes the column of water ahead of it to the surface. Going one step further, we have the latest developments in the pneumatic water works system—we are distributing and delivering water to the consumer not by elevating it and allowing gravity to do the rest, as was formerly the universal practice, but rather by using air pressure from behind to push it along. This method of distribution is rapidly gaining favor by reason of its great simplicity of operation, and because the absence of elevated tanks, windmills, etc., practically does away with danger of frozen pipes.

In the pneumatic system the water is stored in airtight tanks buried under ground, usually in a horizontal position with one end projecting into the pump house. To this end are attached the gage glasses showing the amount of water in the tank, the pressure gage, and the combined inlet and outlet pipe. The tanks are of steel, cylindrical in shape, with slightly bulged ends.

The tanks are kept only partly full of water. The air that is in the tank at first is compressed into the upper part as water is pumped in, and it is apparent that as more water enters, less room is left for this air, and a greater pressure is necessary to confine it to the smaller space. The water, of course, does not change its volume under pressure, as does the air. After the pump has been shut down, this pressure is returned by the air, and forces the water out again, through the distributing pipes, until it reaches the faucet or sprinkler.

As water is drawn off, the air expands into the space thus provided, and the pressure accordingly falls until the minimum service pressure is reached, when the pump is started again, and the tank refilled. An automatic device may be installed for starting and stopping the pump, operating between any desired pressures. If, however, this is not done, the tank must have sufficient capacity to deliver, without too great loss of pressure, the amount required by all users during the time elapsing between pumping.

For obtaining a working pressure when the tank is nearly empty, and for obtaining high pressure at any stage, the air contained in the tank must be given an initial pressure by pumping in additional air before commencing to fill with water. This variation in air pressure follows the adiabatic law, which states that for a given. amount of a gas, pressure will vary inversely as volume. Thus if we have ten cubic feet of air at 20 pounds pressure and wish to compress it to five cubic feet, the pressure required will be 40 pounds.

In the pneumatic water works system pressures are used up to 75 pounds per square inch, but 30 pounds is the one most common. It is of course objectionable to increase the pressure beyond the requirements for service delivery, as this causes an increase in the amount of work that must be done in pumping against the higher pressure. A low working pressure is consequently desirable, and to obtain this several points are to be considered. Care must be taken in the first design and location of the system. If water is available near the surface of the ground, the well should be located as near the point of use as convenient, to save the friction loss on the delivery piping. The driven well should be located near the system center, and may well be driven on a hillside, with the prospect of finding water at a higher elevation than if sought in the drainage bottom. While there is greater freedom in choice of location of a driven well, an open suction well is very desirable, being cheaper to install and simpler to operate; so this choice should be made when possible.

After locating the well, pumping plant, tank, distributing pipes and consumers fixtures, the required maximum pressure is found, to overcome the difference in elevation between tank and highest fixture. To this should be added the loss of head due to friction in the system—depending on length and size of the pipes.

A second important factor in keeping the pressure from rising rapidly is the storing of only a small percentage of the tank capacity, the remaining space being filled with air, forming an elastic cushion. A tank of large capacity is necessary to secure this advantage, one in which the necessary storage may be had at less than half full capacity. With high working pressure this feature of ample tank capacity is very important. For example, a tank operating with 30 pounds initial pressure will store 20 per cent of its capacity with a rise in pressure to 41.5 pounds. A smaller tank—say one-half as large—in storing the same amount would be 40 per cent full, calling for a rise in pressure to 60 pounds, of course necessitating heavier equipment and more work.

A third factor in economical operation is the use of an initial air pressure about equal to the service requirement. The volume of air necessary to put a high initial pressure on the tank is much greater than that required to increase the pressure when the tank is already partly full of water. Hence the former provides greater elasticity, maintaining the pressure more steadily. For example, where a minimum pressure of 30 pounds is required and air pumped in to that figure, then by pumping in 20 per cent of water we raise the pressure to 41.5 pounds. If, however, we start with the tank full of air at atmospheric pressure only, we must pump the tank two-thirds full to get our 30 pounds working pressure; and then, in putting in 20 per cent more water for use, the pressure would have to be put up to 100 pounds. This means that initial air pressure is absolutely essential with high pressure systems, where pumping is not continuous or automatic. It stands to reason that if we are using compressed air as a motive power, the more air we have the better off we are. The situation may be met by having a small air pump driven by the main pump motor, but disconnected at will. It appears that the initial air pressure should equal the minimum working pressure, and that the pump should be regulated to start just before the tank is empty.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Who Exports—and How?

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to take up some of your space in comment and criticism upon the article bearing the above title which appeared in your issue of February 2d.

"American manufacturers have often been abused for their failure to study the demands of foreign markets in regard to packing and for failing to adopt the methods desired by their foreign customers."

The foregoing quotation is most assuredly a statement of facts, as the present writer can testify from his own observations, based on 12 years experience in Central and South America and the West Indies, spent in actual daily contact with the various peoples who inhabit these lands.

However, when the author goes on to say that the matter has been overdone, he exhibits a complete lack of first-hand knowledge of conditions in these countries. As far as the "parrot-like repetition of stories started by foreign business rivals" is concerned, where there has been one case of this kind, there have been a dozen legitimate cases for complaint that have never come to light, simply because the Latin American business man, with his great fund of patience, did not see fit to make them. Tnat the native business man of these lands possesses an infinitely greater stock of patience than his foreign business rival, is so well known as to make it a trite saying.

It is not the intention of the writer to enter into a lengthy discussion of the details of packing goods for export, but, that this highly important detail has been, and still is lightly regarded by the average American manufacturer, exporter, and commission man, is so true that it is known by every man seriously engaged in this field, who has had actual experience in Latin America itself.

There are just three principal reasons why our Latin American customers (native or foreign born), would like to have us follow their instructions and pack goods as directed, which are: first, to avoid payment of unnecessary duties; second, to eliminate as far as possible chances of breakage or injury entailed by rough or careless loading or unloading at the point of embarkation or destination, or which might take place while the goods are in transit, in case of several transshipments; and third, to insure as far as practicable against theft enroute.

Duties in all of the Latin American countries are either based on actual weights, or on the monetary value, of the importations, there being a scale of graduation into classes irrespective of which basis system is used. For example, in Colombia the duties are based on the weight and class of the import. In this and all other countries where a similar system is in vogue, objection to unnecessarily heavy packing arises solely from the fact that this excess in weight invariably augments the amount of duties to be paid. This is brought about by the customs ruling that in certain classes of imports, the weight of the packing shall be included with that of the contents in calculating the duty charges. This is also true, without regard to the class, where the contents are nonremovable, as in the case of liquids etc. From the foregoing it is plainly apparent that customers subjected to such conditions will naturally resent any extra or uncalled for packing, and particularly where it is the result of their packing directions having been ignored or overlooked.

The author of "Who Exports—And How?" apparently thinks that the only essential thing necessary to know is, are the goods to go to a port where the ship can lie alongside a wharf and discharge, or are they going to a port where the discharging must be done into lighters?

Everybody knows that this information is important, but, of how much greater importance is exact knowledge of what takes place *after the goods have been discharged from the ocean carrier*. For example, take imports into Colombia destined for Bogota, with which city one would be led to believe Mr. Marriott has some acquaintance; everything must pass through the ports of either Cartagena or Puerto Colombia (Sabanilla, old name), after which it is subjected to no less than five further transshipments before it reaches the Colombian capital. This makes a total of six distinct transshipments enroute, or twelve handlings, which with the original loading at point of embarkation and the final unloading at Bogota, make no less than fourteen times man has had his hands on these goods! Perhaps the example cited is an exceptional case, but that much of Latin America's imports are subjected to a great deal of interior transshipping, after discharge from steamers at the ocean port of entry, is perfectly true. And as the South or Central American business man is the one and only man in a position to say what condition packages of goods are received in, it would seem the reverse of common sense to ignore his specific directions when preparing shipments for exportation.

Without desire to criticize the morals of the Latin Americans, it must be said that dishonesty prevails to a much greater extent among the lower and laboring classes of the Southern republics than among the equivalent classes in either Europe or the United States. This is invariably the class of labor used in handling imported freight at the port-of-entry, at points where transshipment takes place, and at the final unloading point. Therefore, should damage be done which results in boxes or crates, etc., being broken open, there is some likelihood of theft taking place, particularly where contents are of such a nature as to be useful to the workmen on the ground. No one knows and recognizes this more than the importer of the goods, and because of this fact, he specifically states that packages containing such classes of merchandise shall be particularly well boxed, strapped, etc. The writer has a distinct recollection of being present on several occasions when imports were being received and boxes opened, only to discover that, due to damage done through rough transferring while in transit, or through insecure packing furnished by the manufacturer or exporter, *they were entirely empty*, the "machetes," Gillette razor blades, candles, or whatever they contained, having miraculously disappeared.

"The fact is, that in dealing with South America, it is not so necessary to follow South American customs as might be supposed, for only about ten per cent of the trade goes to real South Americans." This statement, another quotation from "Who Exports—And How?", is very misleading to put it mildly, and the facts if ascertained will not substantiate it. Where Mr. Marriott obtained authorization for this assertion the writer can not imagine, but most certainly not from any actual canvass of Latin America. It certainly will be interesting to Latin Americans to learn that 90 per cent of them have evolved into the professional type of politicians and land-owners. However, for the sake of argument let us assume that this is true; to the writer the main question seems to be, what difference does it make whether the importer in Latin America is native or foreign born? For the question of neither nationality nor birth-place can alter the indisputable fact that whether native or foreign born, the present buyer is a permanent factor, and to be dealt with in the future as in the past. Moreover, none of the conditions incidental to transportation can be affected by the nationality of the importer.

Quoting a shipment of several hundred locomotives to Siberia, to prove that our packing methods are not really unsatisfactory to foreigners, is really "tempting Providence." Of all the many thousands of different articles exported from the United States, there are few if any so practically exempt from the usual risks incidental to exportation as railway locomotives. Made of iron and steel, with boilers rivetted together, and with all parts entirely complete, ready to set up, and with all of the smaller parts such as injectors, lubricators, headlights, etc., all strongly boxed and lashed either to the inside or outside of the tenders, it would be surprising if anything did go astray. As far as injury in transit is concerned, there is little or no likelihood of any, unless for example they land in the hands of some belligerent and destructive Russian revolutionist, who might in time do them some damage, if equipped with a good supply of sledge hammers. I may add that I hold in high esteem the Export Departments of both the large American locomotive concerns that are prominent in export trade, simply because of their expert knowledge of exact conditions.

In concluding this article the writer would say that he possesses a certain and exact knowledge of Colombia and that during his travels in that republic he has seen on the railways quite a number of American locomotives, but that he has also seen, much to his dissatisfaction, as many or more English and German ones, and noted an inclination among Colombian and foreign railway men in the country to purchase more. However, as long as the European War lasts there is no danger of their succeeding. Finally, I am certain that it will be quite a surprise to the author of "Who Exports—And How?" to learn that Medellin, the "coast city" of which he speaks, is 500 miles by any route from salt water! To get there one has to take the Magdalena River route for 425 miles from Barranquilla to Puerto Berrio, after which follows two broken railway journeys of 109 and 60 kilometres each over the Ferrocarril de Antioquia, with a coach trip of 26 kilometres between the two stretches of railroad. All freight, to Bogota, whether locomotives or calico cloth, moves via the Magdalena River (lower), Ferrocarril de La Dorada, upper Magdalena River, Ferrocarril de Girardot, and Ferrocarril de la Saban, so, as this has been the route for a great many years, I am afraid that those American locomotives could not have passed through Medellin, which lies 200 kilometres to the west and far removed from the regular route.

H. L. WOODWARD.

Guatemala City.

Sponsons as an Answer to Torpedoes

To the Editor of the SCIENTIFIC AMERICAN:

The discussions in your columns and the press generally touching a so ution of the submarine menace by the construction of non-sinkable ships has been followed by me with a great deal of interest. But I have been surprised not to find among the many suggestions one utilizing the familiar device used on canoes known as a "sponson."

While I can see no reason why sponsons constructed above the water line with airtight partitions would not in large measure, protect the ship from complete submersion and permit of its ultimate rescue without in any way interfering with the sailing qualities of the vessel, I presume there must be some serious objection to this device—such perhaps as the possible effect on the ship of a large wave striking the ship beneath the sponson. But even this defect could be eliminated in large measure by tapering the lower edge of the sponson, which could be made very strong and rigid by curving out the ship's plates to form the outside of the sponson and constructing the inner wall of a lighter steel.

F. A.

Knoxville, Tenn.

Patentees and the War

To the Editor of the SCIENTIFIC AMERICAN:

I have been hoping to find that you would urge Congress to pass a law that the time, in which war has been raging, should not be counted in the time granted to patentees; in fact, added to the war period, one or two more years should also be given. Patentees have suffered more than anyone else.

T. HENRY PEARCE.

Memphis, Tenn.

The Ventilation of Shoes

To the Editor of the SCIENTIFIC AMERICAN:

On page 216 of the current issue of the SCIENTIFIC AMERICAN I notice an article regarding the ventilation of one's shoes.

For quite a number of years, I have made it a practice to take a large darning needle and puncture through the perforations that are on the tips of my shoes. I formerly suffered severely with perspiring feet and I found that sufficient ventilation came in my shoes by this method.

There is no danger of water entering the shoes, as the holes are so small, and as soon as the water strikes the leather, it causes it to swell and close up. Of course, it is necessary to run the darning needle through the shoes every once in a while so as to keep the holes open.

I have told a number of people about this little idea and it has been of great assistance to them.

FRANK V. CHAMBERS.

Philadelphia, Pa.

Preventing Frosted Feet

To the Editor of the SCIENTIFIC AMERICAN:

The experiments described below are old, and were kept confidential. It is owing to these experiments of mine, that Lord Kitchener decided to send out oil to the troops during the winter of 1914 to prevent frostbitten feet. The experiments are very interesting, and I thought you might like to put them in your world-wide-reputed paper.

An experiment was made on a robust man who put his legs in a bath of cold water up to the knees for one hour, the drop of temperature being tested every ten minutes. During the hour the temperature of the body, taken in the mouth by two clinical thermometers, dropped from 98.4° to 97° Fahrenheit.

A similar experiment was made under precisely the same conditions, but in this case the legs and feet were well rubbed with oil. In this instance the temperature of the body taken in the mouth dropped in an hour from 98.4° to 98.2° Fahrenheit.

In the first case the fall of temperature in one hour was $1\frac{4}{10}$ degrees Fahrenheit, and in the second case, with the legs oiled, the drop of temperature was only $\frac{2}{10}$ degrees. The temperature of the water throughout was 50 degrees Fahrenheit. The man said that at the termination of the first experiment he felt cold and miserable, but after the second experiment he felt warm and comfortable. It is thus conclusively proved that soldiers who have to stand for long periods in cold flooded trenches, by oiling their legs and stockings greatly reduce the risk of frostbite.

I sent these particulars to Lord Kitchener and suggested his sending out some oil to the troops during the first winter to test the efficiency of what I suggested, and he adopted my suggestion immediately, which resulted in its becoming a universal practice in the army during the winter.

I may tell you the experiment was tried on four healthy men with practically the same result in every case. It was tried in the morning an hour after breakfast in every case, and the same food was taken for breakfast throughout.

A. F. YARROW.

Hindhead, England.

Getting the Most Out of the File

A Serious Study of a Common Tool Whose Proper Use Calls for Much Practice

THREE thousand hours of practice is required before one can become a skilled file hand. At least, that is what we are told by French technicians who have made a profound study of this common tool and its uses. The beautiful workmanship so often evident in European products is the result of the skilled use of the file—of skill only acquired after a long and tedious apprenticeship.

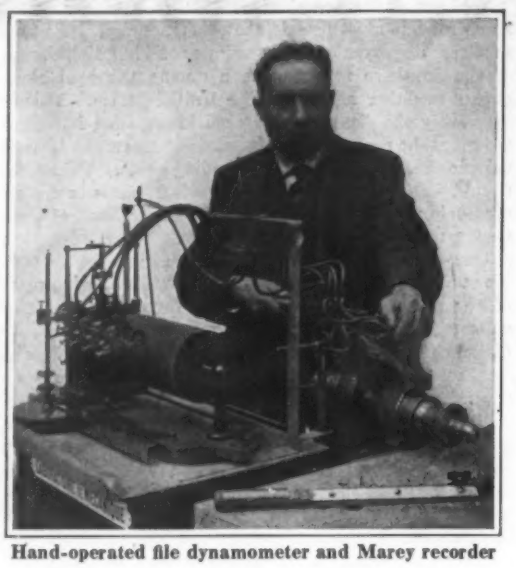
With the introduction of quantity production methods in practically all countries, however, it is evident that the worker no longer can afford to devote 3,000 hours to perfecting himself in the use of the file. Indeed, in this and other respects it seems that the day of the skilled hand is fast drawing to an end, and in his place we are shortly going to find automatic machinery of all kinds and workmen rapidly trained in doing one particular kind of work. So with the file; already, this tool has been the subject of a thorough investigation, and much has been learned which should serve to reduce the period of apprenticeship without taking away from the practical value of the workman.

From a mechanical point of view, the file is a lever connected to two arms which continuously vary in length during the stroke, and the pressure applied by both hands at various times during the stroke should correspond, following a definite mathematical law. Heretofore the skilled file hand has acquired the correct action of the arms and the proper pressures for the hands by practice, but with a better knowledge of just what these actions and pressures are it should obviously be possible to work according to formula rather than according to results obtained.

In his work of reducing the apprenticeship of the file hand, M. Fremont has developed a method which is as simple as it is effective. It consists of having the pupil file at the same time two identical pieces of metal placed parallel and a short distance apart. As the pupil masters the art of filing with the two pieces separated by the original distance, the pieces are gradually moved closer together. This method serves to develop the knack of holding the file perfectly straight, which, after all, is a prerequisite in good filing.

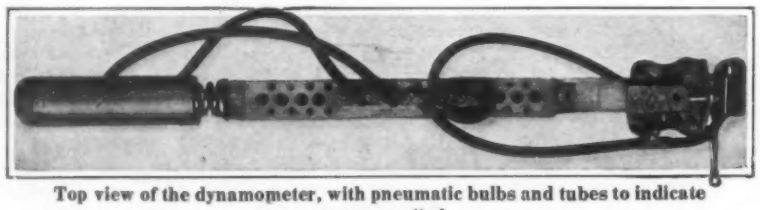
Now to produce useful work the worker must apply pressure on the file so that the teeth will penetrate into the metal to be removed, and at the same time push the file forward in order to remove the filings. The act of filing can therefore be analyzed in this way: First, there is the vertical component or the pressure effort; secondly, the horizontal component or the pushing effort. Each being different for each of the hands, the act of filing resolves itself into four factors.

It is indispensable in studying the functioning of the file to know accurately the value of each of the four factors. In his researches M. Fremont has had constructed a file dynamometer of novel design, two views of which are here shown. With the file held on the under side, the dynamometer is provided with a number of springs of the desired resiliency, as well as several rubber bulbs connected with indicating members for recording the results on rotating paper drums. The springs and rubber bulbs are disposed of in such a way as to indicate the four efforts of pressure and push.

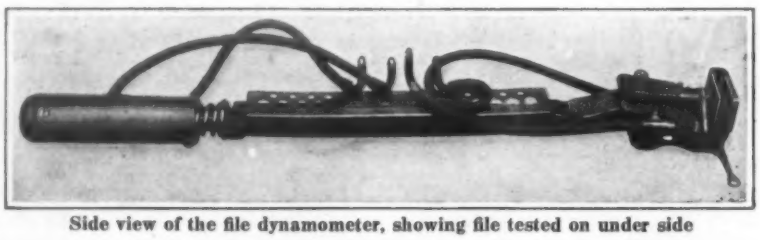


Hand-operated file dynamometer and Marey recorder

In one of the accompanying illustrations appears the complete apparatus of M. Fremont, making use of a Marey recorder. In this manner he has been able to obtain diagrams showing the functioning of the file dynamometer on soft steel, for example, with such information as the course of the file, the time expended, the pressure on the point and on the handle, and the pushing effort on the point and on the handle.



Top view of the dynamometer, with pneumatic bulbs and tubes to indicate energy applied



Side view of the file dynamometer, showing file tested on under side

We are told that the apparent regularity of the file movements obtained by the file hand do not imply straightness of the file stroke, so that these operations are susceptible to numerous causes for error even when the observer is a competent file hand himself. It is necessary to make a rectification of the value of the pressure components for each of the points of the graph obtained with the recorder, since all the graphs are not of the same scale. In this manner we obtain a curve which represents the pressure which should have been applied at different moments if the file had been held perfectly straight.

The results obtained by M. Fremont during various tests proved that for a given file stroke and a given pressure, the pushing effort varies with the kind of teeth of the file and with the metal being filed. And since the study of the pushing effort under various applied pressures can be made with greater accuracy by some sort of machine, the investigator has had constructed a special testing apparatus for files which permits him to multiply his tests and to make certain comparisons. In this apparatus or machine, which appears in another illustration, the pushing effort is measured by the bending of a powerful spring placed back of the file handle. It is proportional to the pushing effort necessary to advance the file on which is placed a certain weight that determines the applied pressure. A crank lever amplifies the bending of the spring while a stylus traces a curve on a fixed sheet of paper.

By means of this machine, M. Fremont was enabled to obtain interesting figures. Tests were carried out with steel, cast iron, brass and copper, and with different applied pressures, proving that in general the pushing effort is greater than the pressure, and diminishes with use.

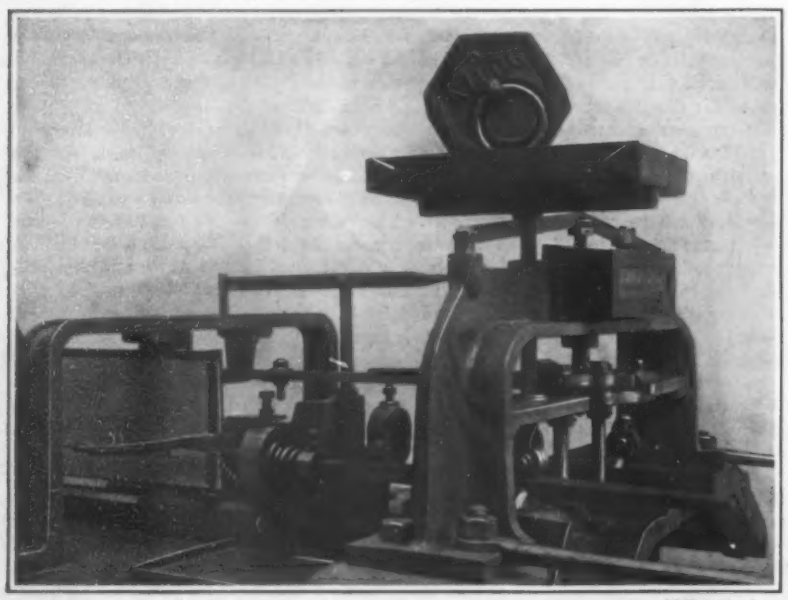
If we suppose that the resultant of the pushing effort, which is horizontal, and the applied pressure, which is vertical, is measured by the length of the diagonal of the parallelogram constructed with these two efforts as sides, the work expended on the file is the product of that diagonal multiplied by the length of the useful stroke. In actual practice, however, the file hand does not file continuously, and the work is greatly influenced by the material filed, the area of the surface in contact with the file, the dimensions of the tool and its shape and hardness of steel, its condition and so on, without counting the factors originating in the workman—physical condition, ability, endurance, etc.

It is of cardinal interest to know how much a file can do; that is to say, the amount of energy that must be put into a file in order to produce a certain weight of filings. It is this knowledge, in fact, that permits one to determine the practical and economic value of files.

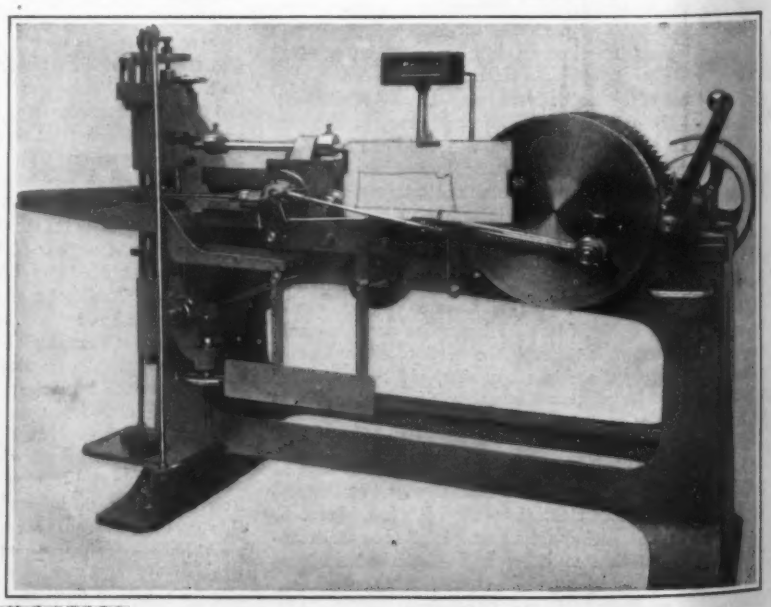
From the tests of M. Fremont we learn that the work done by a file varies according to the metal filed, that it increases with the applied pressure, varying from the regular weight of filings to more than double according to the cut of the teeth. While in practice we make use of the same files for various metals, it is evident that for best results certain kinds of files should be employed with certain metals, the cut of the teeth being determined largely by the resistance offered by the metal to be filed.

Various factors also enter into the output of a file. First we have the heating of the metal being filed, which may augment the weight of the filings some 0.5 grams for every 100 successive strokes of the file. Secondly, a slight, accidental oiling of the work can cause the output to fall off from 10.53 grams to 7.37 grams for the series of 100 strokes influenced by the lubricant. Thirdly, the breaking of the point of the teeth causes a lessening

(Concluded on page 419)

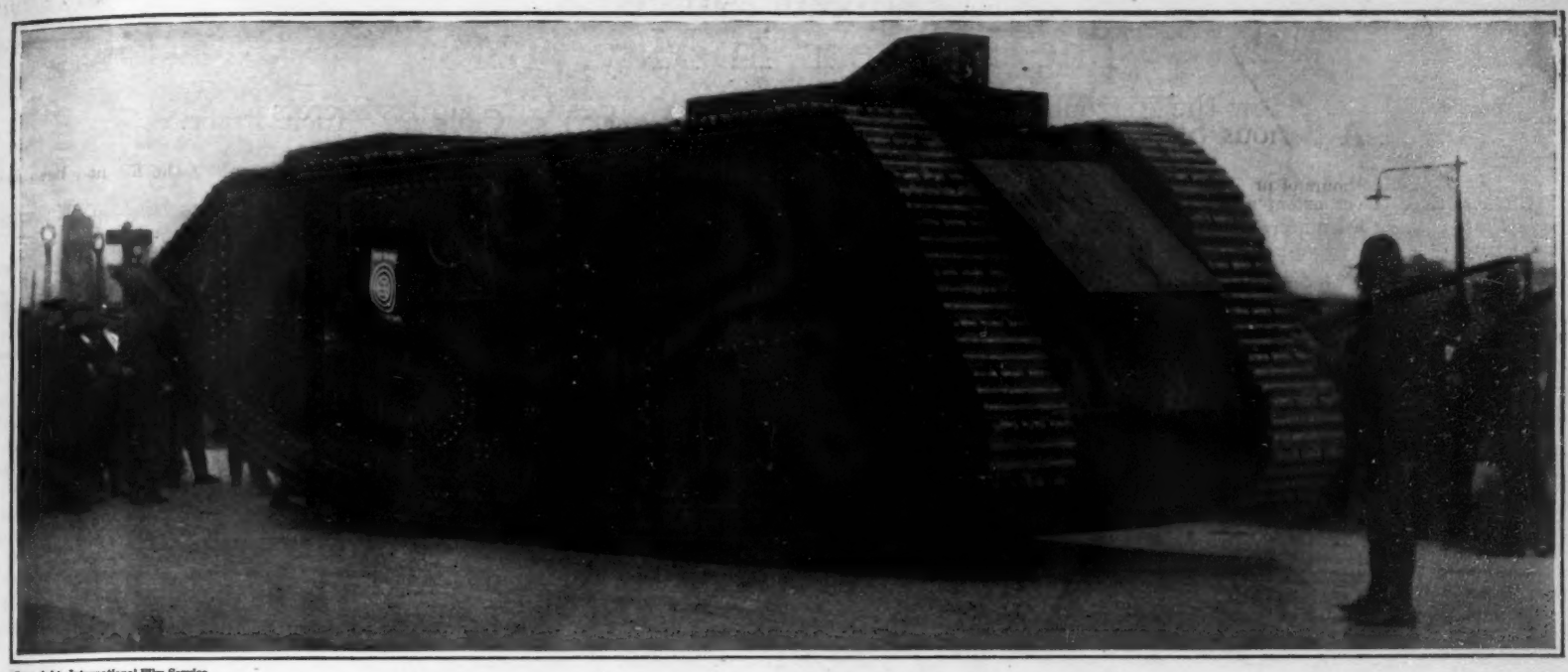


File testing machine developed by M. Fremont, which indicates energy applied under a given downward pressure



Latest file-testing machine of M. Fremont, which greatly simplifies the work and shortens the test

All illustrations by courtesy of Le Genie Civil, Paris.



Copyright, International Film Service

Weighing forty-five tons and driven by steam power, this American tank represents the greatest advance yet made with this modern weapon

Steam-Driven Forty-five Ton Tank for Our Army

OUR military leaders believe in the soundness of the tank idea. That is evident from the accompanying illustration, which depicts a huge tank recently completed for our Army and undoubtedly the forerunner of a large fleet of American tanks.

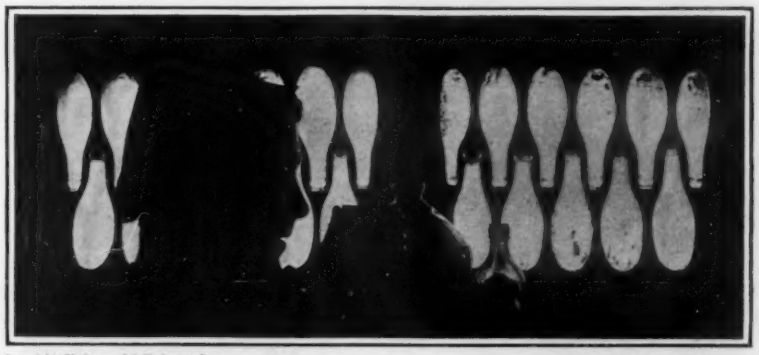
Designed somewhat along the lines of the now famous British tanks, our own weapon of attack is undoubtedly larger and more powerful than anything yet undertaken in this direction. It is steam-driven, which is quite an innovation, to be sure. While the power of the engines is not divulged, the weight of the huge vehicle is given as 45 tons. Judging from the illustration, it appears that the tank is heavily armored, perhaps sufficiently for shell fire.

All in all, and in the absence of further information, it can be said that the new tank known as the "America" marks another step forward in the tank method of warfare.

Discarded Bottles for Dug-Out Windows

TOMMY ATKINS is quite as ingenious as his *poilu* partner. In fact, it is his ingenuity that makes for those little comforts at the front without which the soldier's life would hardly be worth living.

And here is genuine proof of Tommy's ingenuity. Taking the discarded soda bottles which are found in abundance back of the lines, he has converted them into dug-out windows in the manner shown in the accompanying illustrations. Held in place with a little cement, the bottles make practical and even artistic windows for many a British dug-out these days.



Copyright, Underwood & Underwood

Enough light is admitted by this novel window to permit of shaving

Copyright, Underwood & Underwood

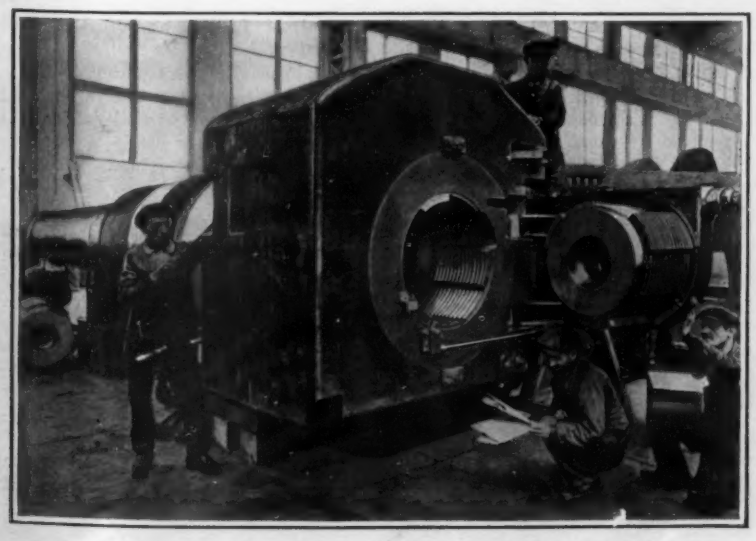
Set in cement, empty soda bottles make good dug-out windows

The Creusot 520-Millimeter Weapon —This War's Most Powerful Gun

THE recent publicity given the long-range German gun has quite overshadowed the French 520-millimeter gun, which after all remains the most powerful gun now in use. Whereas the German piece throws its shell some 75 miles, the French gun is relatively a howitzer hurling a huge shell a comparatively short distance. Practically speaking, it is a fort wrecker of proved powers.

For some time there had been rumors of a 520-millimeter gun employed by the French artillerists, but ordnance experts and others familiar with the difficulties in the way of producing such a powerful piece of mobile artillery did not place much credence in the unofficial descriptions; they preferred to wait for some definite evidence.

It was not until the French official films presented the 520-millimeter gun to American audiences that ordnance experts and others were convinced that the huge mobile howitzer was a *fait accompli*. The accompanying photographs which have recently reached this country show one of these huge guns receiving the final touches at the Creusot works in France, and another similar gun in action. It appears that the gun is a howitzer mounted on a railroad carriage, and fires a shell measuring 20.47 inches in diameter. As a fort wrecker, this gun is undoubtedly without peer, the German 420-millimeter and the Austrian 300-millimeter howitzers having been outdone by a good margin. During the French attack on Fort Malmaison it is reported that a single 520-millimeter shell crumbled this permanent fortification upon which the Germans had spent so much time and labor.



Breech end of the Creusot 520-milimeter gun, which fires a shell of 20.47 inches diameter

Copyright, Kadel & Herbert

Mounted on a railroad carriage, the French 20.47-inch gun is a highly mobile weapon

The Heavens in May, 1918

How the Astronomer Makes the Vastness of Space Give Up Its Secrets

By Henry Norris Russell, Ph.D.

OUR knowledge of the extent and structure of the sidereal universe has undergone a very rapid extension within the past few years, and it is now possible to determine with fair accuracy the distances of objects which, not long ago, were utterly inaccessible to investigation. Reference has already been made in these columns to the remarkable results which have been attained in the study of the great globular star-clusters. A recent paper by Dr. Shapley, of the Mount Wilson Observatory, extending his studies on these clusters to a noteworthy degree brings out new facts of a character surprising even to astronomers themselves.

The Globular Star-Clusters

It has long been known that globular clusters are not uniformly distributed over the sky, nor do they, like most other celestial objects, congregate toward the plane of the Milky Way. Instead, they are almost confined to one-half of the celestial sphere (with its center in the constellation Scorpio, in 17 h. 30 m. right ascension and 30° south declination) which contains more than sixty such clusters, while in the opposite half of the heavens there are less than half a dozen. This shows, of course, that our solar system is nowhere near the center of the region of space within which these clusters are situated, but must be nearly at its edge. How large this region is, however, and in what manner the clusters are distributed within it, was completely unknown till Dr. Shapley began his investigations.

To get any idea of the distance of so remote an object as a globular cluster, we must apply methods more powerful than the geometrical measurement of parallax, which does very well for the nearer stars.

Fortunately, it is now possible, in many cases, with the aid of our knowledge of the distances of the nearer stars, to show that stars possessing certain easily recognizable characteristics, are, whenever we can study them, found to be of a certain definite, absolute brightness. The most notable example is furnished by the short-period, or Cepheid, variables. These stars, which vary in brightness in a very characteristic way, are in all cases found to be very much brighter than the Sun. Dr. Shapley, from a careful study of more than two hundred of them, finds that the average brightness of such stars depends on the period of variation. Stars of this sort with a period of one day are all about one hundred times as bright as the Sun. Those with a period of four days average 400 times as bright as the Sun, and those with periods of 10 days are 1,500 times as bright as the Sun. The average brightness increases rapidly with the period, while stars of the same period are very similar in brightness.

Now a variable star of this sort, however distant and faint, can be readily recognized by its distinctive type of light change. Many such stars occur in the globular clusters—especially those of short period, which are actually about one hundred times as bright as the Sun. It is an easy matter to measure how bright these stars look to us; then, knowing their real brightness, we may calculate their distances and hence the distance of the cluster of which they are members.

Thus we obtain the distances of all the clusters in which variable stars have been discovered. How about the others? Dr. Shapley solves the problem very ingeniously, first by observing that, in each of the clusters where variable stars appear, the brightest stars of the cluster are, on the average, three times as bright (photographically) as the variables. As these bright stars are almost all strongly red, they are much brighter visually than photographically, and, measured with the eye in the ordinary way, they would average about a thousand times as bright as the Sun.

Knowing this to be true, we have only to measure the brightness of the brightest stars in any cluster to get its distance. In this way 30 clusters have been studied and it is found that there is a very definite relation between the distances of the clusters and their apparent diameters on photographic plates with equally long exposures. Having studied this last relation, Dr. Shapley was in a position to estimate the distances, in one way or another, of *all* the known globular clusters; and then to prepare diagrams showing their actual distribution in space. The results are simply amazing; but they have been derived after very careful scrutiny by an extremely competent investigator, and are thoroughly worthy of confidence.

What Those Clusters Tell Us

The nearest of the globular clusters—Omega Centauri and 47 Tucanae, both in the southern hemisphere—are at about equal distances of 22,000 light years. Each of these clusters is easily visible to the naked eye (though not in our latitude) and the total light given out by all the stars of either one must be something like a million times the light of the Sun.

The great cluster in Hercules is about 35,000 light years away and this, too, is one of the nearer ones. The remotest cluster so far investigated—a faint and apparently small object bearing the number 7006 in the "New General Catalogue" of clusters and nebulae—is at the enormous distance of 220,000 light years—at least fifty times as far away as the remotest star whose distance we could hope to measure by other methods.

Calculating the actual positions in space of the 69 clusters definitely recognized as globular, Dr. Shapley finds that they, themselves, form a huge flattened cluster, probably 300,000 light years in diameter, and about 100,000 light years in thickness (omitting a few scattering clusters). The diametral plane of this great system coincides with the plane of the Milky Way—very few of the clusters being more than 50,000 light years from this plane. The center of the system is apparently about 70,000 light years from the Sun, in the direction of the great star clouds in Sagittarius.

These very remarkable facts indicate strongly that the globular clusters, after all, are really members of the same enormous system as the stars of the Milky Way, and that the whole system is enormously vaster than any one had previously dared to imagine. Near the central plane—that is, within 4,000 light years of it—there appear to be no globular clusters; and it is just within this central region that there lie all the stars visible to the naked eye, almost all the brighter telescopic stars, and all the gaseous nebulae.

The reason for this remarkable arrangement is still unknown; but this, and the other problems raised by this extraordinary piece of work, will evidently afford material for many workers for years to come.

At 12 o'clock: May 7.
At 11½ o'clock: May 15.
At 11 o'clock: May 22.

At 10 o'clock: June 7.
At 9 o'clock: June 14.
At 9 o'clock: June 22.

At 10½ o'clock: May 30

Hours refer to summer clock time in effect March 31.

NIGHT SKY: MAY AND JUNE

The Heavens

Turning to our star map we find the great old star Arcturus in the south and high in the sky. Below it, and a little to the left, is the fainter Spica, in Virgo. Well up in the west is Leo, with the familiar Sickle, and the planet Mars above it, and brighter than any of the neighboring fixed stars. Below these constellations stretches the ungainly length of Hydra.

The northern part of Centaurus is visible low in the south (its brightest stars being below the horizon) and most of Scorpio has risen in the southeast. Ophiuchus fills most of the southeastern sky. Aquila has just risen in the east and Cygnus in the northeast, with Lyra above it. Hercules and Corona are higher up—the last close to the zenith. Draco and Ursa Minor are above the Pole, Ursa Major high on the left, and Cassiopeia low on the horizon. Gemini and Auriga, are setting in the northwest, and Cancer, low in the west, is brightened by the presence of the planet Saturn.

The Planets

Mercury has just passed through inferior conjunction, and is a morning star this month. He is best visible about the time of his greatest elongation on the 24th, when he is 25 degrees from the Sun, and rises at 4.35 A. M. (by the newly adopted "summer time"). He is then in Aries remote from any bright fixed star, and should be easily identified.

Venus is a morning star all through the month, rising about 4 A. M., and is extremely conspicuous.

Mars is in Leo, and though past opposition and receding from the Earth, is still a very conspicuous object, about as bright as Arcturus. He remains in sight till about 4 A. M. on the first and 2 A. M. on the thirty-first.

Jupiter is an evening star in Taurus setting at 10.30 P. M., at the beginning of the month, and two hours earlier at its close.

Saturn is likewise an evening star, in Cancer, and sets a little after 1 A. M. in the middle of the month.

Uranus is in Aquarius, and is in quadrature east of the Sun on the 19th, so that he is observable before daybreak.

Neptune is in Cancer, and observable (telescopically) in the evening.

The Moon is in her last quarter at 6 A. M. and the 3d, new at 9 A. M. on the 10th, in her last quarter at 4 A. M. on the 17th, and full at 7 A. M. on the 25th. These hours, like the others in this article, are given in the new "daylight saving" time, according to which the Sun crosses the meridian at 1 P. M.

The Moon is nearest us on the 8th and farthest away on the 20th. She passes near Uranus on the 4th, Venus on the 7th, Mercury on the 9th, Jupiter on the 12th, Neptune on the 15th, Saturn on the 16th, and Mars on the 19th—none of the observable conjunctions being close.

Comment on any astronomical discoveries that may have been made within the past fortnight is delayed till next month, as the writer is temporarily absent from home on public business.

Ellington Field, Texas April 9, 1918.

Making Coke Into a Suitable Household Fuel

RENDERING coke avilable for heating purposes in domestic stoves and hearths is a recent novel suggestion and especially opportune just at this time. It has not hitherto been practicable to do this because coke burns too quickly and with too intense a heat. Damage is also done to stoves and hearths. The rapid combustion calls also for more frequent replenishing of the fire.

An interesting method of overcoming these difficulties and making coke a suitable fuel has been worked out in Germany. The coke, preferably of medium size, is introduced into a liquid mass which contains, mixed in water, a mixture of about thirty parts of coal dust and twenty parts of loam. The mass is well stirred with the coal and is absorbed greedily by the highly porous coke so that all pores are filled with this mixture. According to its size the coke is left from twelve to twenty-four hours in this bath and, after it has been removed, it is treated with a mass, also composed of coal dust, loam, and water, but less liquid than the other bath. The coal dust and loam may be employed in equal parts and may be mixed to a thick paste with the thick sediment from the previous bath. The coke is stirred into this paste with a shovel or by the use of a revolving drum until the mass has formed a complete coating on the coake. The lumps, after they have slightly dried, are preferably powdered with pure coal dust to improve their appearance.

The dust introduced into the coke by the bath and the coating is claimed to serve as a substitute for the fuel substances which have been removed from the coke, while the loam or some other noncombustible earth will prevent a too rapid combustion. The drying should preferably be performed in open warm air.

Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University

Calculations for the Farm Engine

THE small gas engine and the farm tractor are fast becoming commonplaces on the American farm, and it will not come amiss to the owner of such machines to be able to determine the proper size pulleys to be used on different machines, so that they may be operated at their correct speeds. Many times an operator has been guilty of guessing at the size of pulley for the machine which he has purchased for use with the engine already installed. Doubtless many farmers have thought that a knowledge of mechanics was necessary to solve such problems; but as a matter of fact, all that is needed is ability to apply simple arithmetic to a few easy formulas.

The diameters of driver and driven pulleys must both be expressed in inches or both in feet. Then all that has to be remembered is that the product of the diameter and the number of revolutions per minute must be the same for both pulleys. That is, if R and D represent the revolutions per minute and the diameter of the driver pulley, and r and d the same items for the driven pulley, we have

$$R \times D = r \times d$$

And that is all there is to it, as a couple of simple examples will make clear.

Thus, suppose a man has a gasoline engine with a pulley 10 inches in diameter and running at 400 r.p.m. He wishes to know what size pulley it would be necessary to install on a feed mill to be run from this engine at a speed of 800 r.p.m. Substituting in the formula the three known quantities, he gets at once

$400 \times 10 = 800 \times$ the diameter to be found

$4{,}000 = 800 \times d$

$4{,}000 \div 800 = 5$ inches, the size pulley for the mill.

It will be realized that in this manner, if any three of the factors are known, the fourth may be found. Suppose in the same case as that considered, the mill has a 6-inch pulley; how fast would the engine then have to run in order that the mill develop the same 800 r.p.m.? This time it is R that we are to find; and substituting the known quantities in the formula, we have

$R \times 10 = 800 \times 6$

$R \times 10 = 4{,}800$

$R = 4{,}800 \div 10 = 480$ revolutions per minute.

If it is a gear train that is to be considered instead of a smooth belt pulley, the only difference is that instead of the respective diameters of the pulleys, we must use the number of teeth on the two sprockets. Representing these numbers by T and t, our formula then becomes

$$R \times T = r \times t,$$

and we use it just as before.

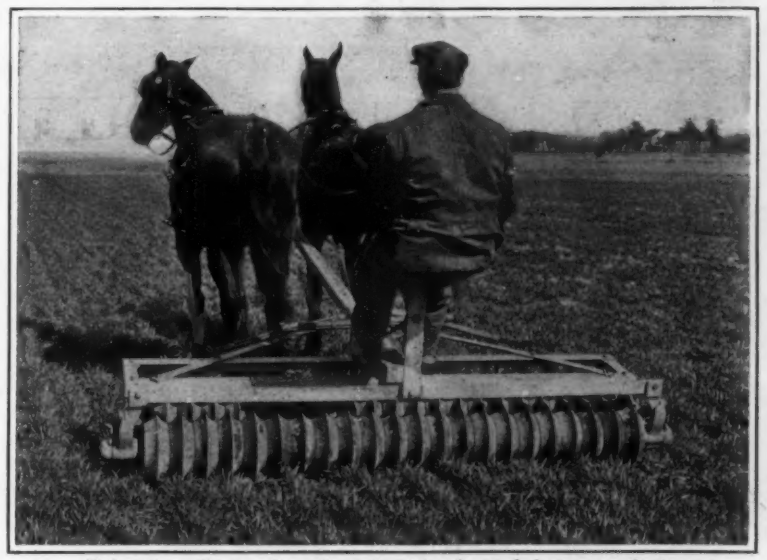
(*Concluded on page 419*)

Getting out the troublesome small weeds

A Weeder Attachment for Cultivators

THE careful farmer always looks with some concern upon the very small weeds that are frequently left in hills of corn during the first or second cultivation, and which he can neither root out nor cover up. The weeder attachment shown in the illustration above will frequently be found very effective under such conditions.

This weeder is so attached that it is raised and lowered with the cultivator gangs. The depth to which it penetrates can also be accurately regulated. It is especially valuable in the cultivation of potatoes. It can be used when the vines are several inches high, and weeds which later never can be reached with the cultivator can be killed. It cannot be successfully used in cultivating corn if the soil is too lumpy.



Using the roller-crusher where frost has heaved the young plants

A New Tillage Tool

THE moisture content of the soil is one of the controlling factors in crop production. In the corn belt of the United States the natural rainfall is depended upon to supply growing drops with an adequate supply of water. While in the minds of some, irrigation even in this humid area might be economically practiced, especially on the more intensely cultivated crops such as potatoes, effort is largely directed toward the conservation of the natural supply of moisture.

In the past twenty years there have been many types of land rollers invented, each designed to crush clods and compact the soil. The older type, the drum roller, has been in use for many years. Its careless use leads to the loss rather than to the conservation of moisture, due to the fact that the surface of the soil left smooth and compact would crust over. With no mulch to stop the capillary rise of moisture from below tons of water would then be brought to the surface and would evaporate in a relatively short time.

There were many new designs brought out which in various ways attempted to remedy this defect. The so-called "gas-pipe" roller and the "crow-foot" roller, have found some little favor, but neither has been widely used.

The roller-crusher shown in the accompanying figure is the latest invention of its kind to find any extended use. Two rollers placed in tandem are here illustrated, this being the better type, though a single roller type is made. Each roller is made up of disks, or sections, with the V-shaped surface as shown. The sections are simply slipped over a shaft which serves as an axle with a bearing at each end. The sections may turn independently on this shaft, though as a rule they rotate with it. It will be noted that the crown of the "V" of each of the rear sections follows the lowest point of the preceding sections. Thus, in actual operation the ridge formed by any two adjacent sections is split by the section immediately to the rear, a part of the soil being forced to the right and a part to the left. This insures actual movement of nearly all the surface soil, which results in a much finer tilth and more effective crushing of clods than with a solid drum roller. For the same reason it is very effective as a clod crusher.

The soil is firmly compacted just beneath the surface, which is left ridged and loose, so that not only is the rise of moisture from below interfered with, but what does rise to the surface is not so readily evaporated.

A sample of the new tool's work in crushing clods

The new roller-crusher in a field of young corn

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

This toy tank fires a stream of wooden bullets

Toy Tank With a Workable Machine Gun

THE latest creation of a toy inventor of Springfield, Mass., is a diminutive tank that carries a workable machine gun. Not only can the youngsters enjoy the realistic maneuvers of the tank to the utmost, but there is the added attraction of pouring a stream of wooden bullets into miniature trenches and shooting down toy soldiers.

The latest toy tank is made of wood painted a war gray. The tractor belts are made of canvas strips on which are tacked short lengths of dowel stick at regular intervals, and as the tank is pulled by means of a string the tractor belts slide over rollers and permit the tiny vehicle to move forward in the same manner as its prototype "over there." When a suitable position is reached, the youthful operator of the tank can discharge a string of bullets by turning the crank of the machine gun. The ammunition in the form of wooden bullets, is fed into the gun from the top, as shown in the illustration, a metal weight serving to press down the bullets and insure positive feed.

One-Man Portable Scoop Conveyor

AN interesting variation of the conveyor belt, is a portable belt and scoop conveyor that is made to be operated by one man only. With it one man and a shovel can load a ton of loose material such as coal, coke, ashes, crushed stone or gravel a height of eight feet into a wagon or other carrier in extraordinarily quick time. If two or more of the conveyors are used at once (as shown in the second illustration) the load may be carried to nearly any multiple of eight feet.

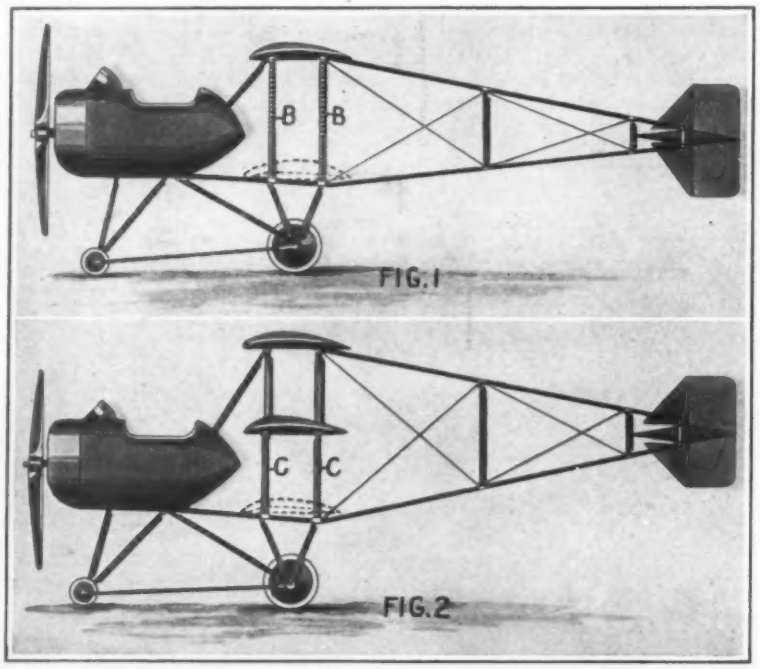
The machine also will handle sacks of potatoes, chicken feed or other like material as well as assorted packages, if desired.

The scoop can be run either by an electric motor or by a gasoline engine. Its nose or scoop is thrust into the material to be loaded or carried up, and then the shovel man keeps a steady stream falling on the scoop.

Eliminating a Wing to Increase Airplane's Speed

DECREASE the wing surface of an airplane and you increase its speed at the expense of lifting power. With this fact in mind, Edward Victor Hammond of Balham, Surrey, England, has worked out the ingenious airplane arrangement depicted in the accompanying drawings. His invention, it will be noted, provides means whereby the lifting or weight-carrying capacity of airplanes, and also the speed and climbing abilities, can be varied as desired. The two drawings show, respectively, the arrangement for a biplane and a triplane. In a biplane machine the inventor causes the lower plane or planes to be raised into such a position as to close firmly against the underside of the top plane or planes, by means of revolving the interplane struts *B*, thus transforming a biplane into a monoplane. In a triplane machine the lowest plane or planes are caused to be raised into such a position as to close firmly against the underside of the center plane or planes, thereby transforming a triplane into a biplane. In both these instances the closing of the plane is brought about by revolving the interplane struts, which struts are shown at *B* and at *C*.

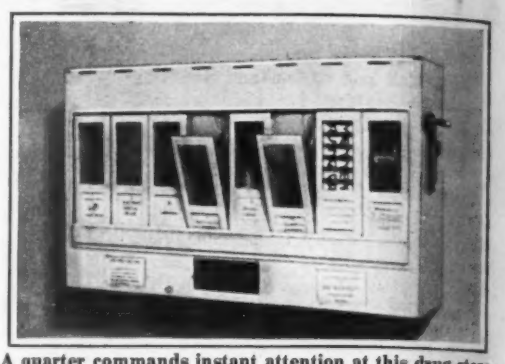
The interplane struts in Mr. Hammond's plans are threaded with a screw thread for their whole length in the case of the biplane machine. In the triplane the screwed interplane struts are threaded on their lower halves, the screwed struts passing through sockets in the collapsible planes. It will be obvious that when the threaded interplane struts are revolved by any suitable means, the collapsible plane or planes will be lowered or raised in accordance with the direction of motion of the operating gear.



Schematic plans for converting a biplane into a monoplane and a triplane into a biplane while in flight so as to increase speed

A Coin-Operated Drug Store

THE traveler's needs these days are largely met by a coin-operated drug store installed in the bath room of his hotel. For, with a quarter available, he can secure any one of eight different toilet articles without leaving his rooms and without delay or inconvenience. The coin-operated drug store is a neat cabinet of pressed steel, containing eight compartments each provided with a glass front so as to indicate the contents. In each compartment is placed a 25-cent package of some standard toilet article, such as shaving powder or cream, healing lotion, talcum powder, cold cream, and so on. To operate the automatic drug store, one has merely to place a quarter in any one of the slots, and pull the lever at the right of the cabinet. Whereupon the compartment containing the desired article is released and springs open as shown in the illustration.



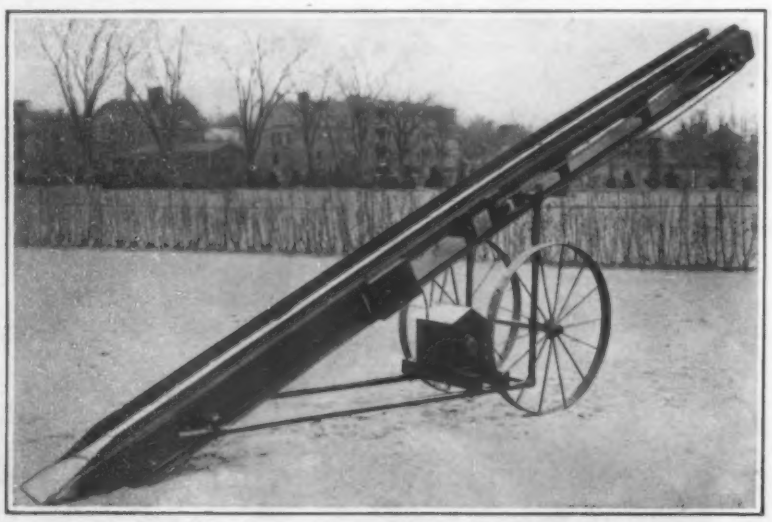
A quarter commands instant attention at this drug store

Non-actinic Light for Photographic Use

A NEW method employed by J. Bardin in France makes use of the principle of platinum sponge, which is first heated in a flame, and then preserves its heating power when exposed to vapor of alcohol, ether or gasoline. The inventor makes use of this property by employing a small round tablet made up of a platinum salt, a lithium or strontium salt, asbestos, magnesia and alumina. A small bottle or lamp holding alcohol, etc., is provided with a wick with flat top upon which is placed the tablet, and after lighting and then blowing out, the tablet glows with a red or other non-actinic light which can be used in the dark room.

Briquets from Locomotive Waste

IT is stated that the French railroads alone lose 200,000 tons of combustible product per annum, which can, however, be readily made up into briquets or balls, and the fuel thus obtained is quite as good as the usual briquets. This product is in fact no other than the waste material which collects in the smoke box of locomotives, and its heating power is no less than 7,000 calories. The war conditions, with their resulting economy, have now led to the use of this substance, and it is stated that a French manufacturer is engaged in the purchase of the combustible from the railroad companies and is making up briquets by its use. A French patent has been obtained for the use of this material, one point being that it is neither coal (which has been now burned), nor coke, for it results in fact from the distillation of coal.



A cross between conveyor-belt and push-cart

Loading a coal truck with the aid of a one-man portable scoop conveyor

This shows the outfit of the Dayton "D" Handle Co., Dayton, Ohio, a 5-ton Troy Trailer being operated behind their 2½-ton truck. With this outfit used for hauling heavy timber, they have more than doubled the hauling capacity of their truck

FOUR wheels and a frame won't make a trailer to be operated behind a motor truck.

A motor-truck trailer must be so designed that every wheel takes care of itself when meeting road obstructions. There can be no whipping motion. There can be no side-thrust in rounding corners—no strain on wheels, frame or steering gear. The wheels always must be parallel to the line of traction.

There must be an absolute automatic steering mechanism, so that whether there are one or more trailers in the train, each one will follow in the exact track of the truck, around corners and regardless of road conditions. There must be prevented any and all shocks from sudden starts and stops.

To travel at 4 to 15 miles an hour and under load, without steering—to back into or pull out of a crowded corner—to hitch up to any truck and stay hitched—to take any road day after day, without injury to itself or the truck—to pass through a narrow gateway on a curve without collision—in a sentence, to meet and extend all the desirable conditions of modern trucking traffic at a profit to the operation and to remain a sound, dependable mechanical asset in an enlarged scheme of tranportation, calls for a vehicle such as was never before designed.

Troy Trailers have gone through all of this evolution of design and test, re-design and re-fest—and then years of experiment in actual service—and they have done this with wonderful performance.

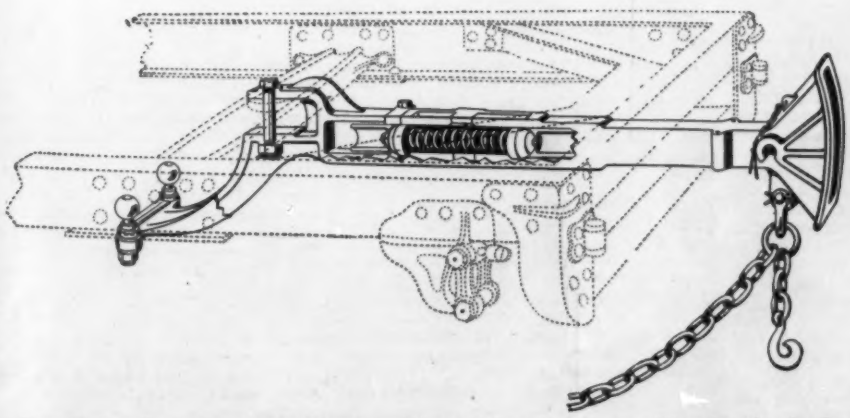
Troy Trailers do not contain a single wagon part. They are built entirely of bronze and steel, with wood only in the wheels.

Compound draw-bar heads and couplings allow unimpeded motion in the connection between the truck and trailer.

These coupling features take not only the up and down and sideway fluctuations, but all the angles in between.

The "pull" is through the frame and springs, not on the axles and wheels. In other words, the load itself starts to move before the wheels do. A powerful coil-spring in the draw-bar takes up all shocks, and thereby safeguards both trailer and truck from shock damage.

That is why as much engineering skill is required in building Troy Trailers as it takes to build the best trucks.



Troy Trailers "pull through the frame"—not through the axles. A powerful coil spring in the draw-bar takes up all shocks, and thereby safeguards both trailer and truck from shock damage.

The Troy Wagon Works Co.

Troy, Ohio

Oldest and largest makers of Trailers, making possible highest grade construction at lowest cost.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

DIAPER SKIRT.—EMMA W. COLMAN, care of Howard Mott, Tenafly, N. J. The object of the invention is to provide an envelope diaper skirt which will serve as a substitute for a flannel petticoat and which will remain in normal position and protect the child's abdomen and loins, no matter in what position the child may be held. The envelope diaper skirt covers the diaper and gives warmth and comfort where most needed.

Electrical Devices

DISTRIBUTION BOX.—E. H. NEGLEY, Canton, Ill. The invention relates to distribution boxes for use in connection with electric light and power service. An object is to provide a distributing box which may be fastened to a pole and by means of which the connection of the individual wires leading to various customers, residences may be quickly made, a further object is to provide a device which will eliminate the strain ordinarily placed on the main supply wires.

Of Interest to Farmers

SPREADER.—E. C., J. C. and W. A. HINKLE, R. F. D. No. 2, Loretto, Neb. The object of the invention is to provide mechanism for spreading straw, fertilizer and the like, wherein a vehicle is provided having means for moving the material longitudinally of the body to distributing mechanism arranged at the rear of the body for distributing the material over a wide area as the vehicle is moving.

ATTACHMENT FOR HEADERS AND HEADER BINDERS.—D. E. HUBTIG and F. L. HAGGART, Delphos, Kans. By this invention the header is propelled by a motor driven drive shaft extended centrally and longitudinally with the trend of the header, an object is to provide mechanism capable of being attached t existing machinery of the harvester type, for connecting the wheels of the cutting and binding mechanism of the harvester to a motor driven shaft as used in connection with self-propelled machines.

DITCHING MACHINE.—M. J. JACOBS, 1101 3d St., North, St. Cloud, Minn. The invention has for its object to provide mechanism for first spading the ground to loosen the same and to provide other mechanism for removing the loosened soil from the ditch. The machine comprises a wheel supported frame and a series of spades in connection with the frame, the loosened soil is removed from the ditch by means of an endless carrier consiting of a supporting frame in which is mounted an endless apron having blades or vanes.

Of General Interest

SUBMARINE LIFEBOAT.—ST. CLAIR LEWARK, Mamie, N. C. This invention relates particularly to a surface boat attached to a submarine or underwater boat in such manner that it may be readily and quickly detached and of such construction that when detached it will promptly rise to the surface of the water, the lifeboat having means to prevent it from sinking and which tend to maintain it in upright position in use.

RAZOR.—G. F. CONNORS, 524 E. 8th St., Leadville, Colo. The object of the invention is to provide a razor holder wherein interchangeable blades may be used without departing from the construction of the non-safety type of razor, the holder is formed by bending sheet metal into proper shape, the strip being doubled upon itself

A SIDE VIEW WITH PARTS BROKEN AWAY

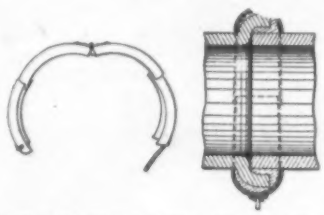
to form the holder, the side walls being close to each other when the razor is not in place, the blades are the whole length of the holder, the width extending to leave enough of the edge exposed to permit of shaving, stropping and honing. By this device the razor may be used in the same manner as the old-fashioned type.

DISPLAY TABLE.—J. M. ELLIOTT, Shelby, N. C. An object of the invention is to provide a table which is primarily designed as a writing table for the lobbies of hotels, and in which is displayed advertising matter, underneath glass plates, means being provided whereby one edge of each of the glass plates is covered by an ornamental receptacle which can be removed for permitting the grasping of the plate by the edge to lift it from the table when it is desired to remove or insert the advertising matter.

DISINFECTANT CONTAINER FOR TRAP-GUARDS.—G. A. SLEGHT, Hyde Park, N. Y. The object of the invention is to provide a construction and arrangement whereby disinfectant may be caused to act not only as a disinfectant, but as a deoderizing agent. Another object is to provide a container of a particular type in connection with a trap for urinals whereby the disinfecting material is located in such a manner as to produce the best results without waste.

SUPPORT FOR CURTAINS OR THE LIKE.—A. E. MENZIL, cor. Steinway and Riker Aves., L. I. City, N. Y. Among the objects of the invention is to provide a simple, portable and easily manipulated apparatus adapted to be moved from one window to another during the operation of cleaning the windows for the purpose of holding window curtains well away from the window, so as not to be soiled or obstruct the cleaning operation. Another object is to provide a portable, foldable rack for the purpose of hanging towels, cloths and other fabric articles.

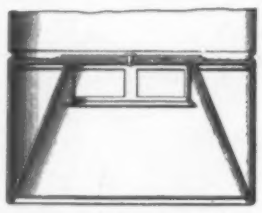
JOINT PROTECTOR FOR SEWER PIPES.—F. W. LANG, 609 Plymouth Ave., Minneapolis, Minn. The invention relates to joint protectors for sewers or similar conduits, which are made up of pipe sections, the usual cemented joint between sections often becomes dislodged and the faulty joint not only leaks water, but permits the roots of trees to work their way into the pipe. The



FRAGMENTARY LONGITUDINAL SECTION AND PROTECTOR OPENED

object of the invention is to overcome this by the use of a joint of annula form constructed from sheet metal, this protector is made up of connected quarter sections adapted to be opened up and applied around the cement join before it is set. The sections are connected by an ordinary strap hinge, and a single rivet loosely connects each section. The free ends of the sections are overlapped and adjustably connected by a fastening comprising a loop and a metal strap.

WELL BUCKET.—T. J. MCKINNON, Box 236, Livingston, Texas. The invention relates particularly to a bucket adapted to be used for cleaning and also for drawing water from drilled



VERTICAL SECTION THROUGH THE LOWER PORTION OF THE BUCKET

wells, this bucket has a cylindrical cutting edge which loosens and scrapes off the silt and other trashy matter that may adhere to the well tube.

CHECK BOOK HOLDER.—J. B. MORRIS, Miltonvale, Kans. One of the principal objects of the invention is to provide a check book holder of convenient size for the pocket adapted to hold and protect a pad of checks in such manner as to eliminate the fold in the center of the check, so that the checks will always be straight and smooth and afford a good writing surface, a loop is slidably disposed around the folder over portion for holding the book in closed position.

SUBMARINE SPAR NET SHIELD.—S. B. and W. G. WILLIS, 582 Broome St., New York, N. Y. Among the principal objects which the invention has in view are, to provide obstructions which may be placed in the path of an attacking submarine, to prevent the submarine following in the wake of an escaping vessel, to provide means for preventing torpedoes striking the hull of a vessel when the attack is directed broadside of the vessel, and to provide safety devices which after being used for the attainment of the primary object, may be used as traps for submarines.

COIN SEPARATOR.—W. B. PUNT, 228 Academy St., Jersey City, N. J. The invention has for its object to provide a construction whereby coins of any kind, within certain limits, may be inserted through a single opening and caused to be properly segregated into their respective places, the device is especially adapted for conductors, or other persons collecting coins. A further object is to provide an automatic distributing chute for receiving and distributing the coins by the action of gravity.

Hardware and Tools

NUT LOCK.—C. R. COCHRAN, address Mrs. ELLA COCHRAN, P. O. Box 95, Vale, Ore. An object of the invention is to provide a locking element in the form of a detachable key constructed to be countersunk in a face of a nut and engage the threads of a bolt. Another object is to provide the nut with a form of recess for receiving the locking element whereby the same is retained in its locked position and the removal of said element from the recess facilitated to permit the nut to be unthreaded from the bolt.

CALIPERS OR SIMILAR MEASURING INSTRUMENTS.—G. F. KUHNE, 44 Washington Place, East Rutherford, N. J. The object of the invention is to provide an inside and outside caliper, arranged to permit the user to accurately set the instrument to any degree of opening, and to allow of further opening after it is set, with a view to pass it over an obstruction and then accurately reset it to the original opening. The invention consists essentially of arms hinged together, one arm being provided with a series of notches, a pivot on the other arm, a threaded link slidably engaging the pivot and provided with engaging means adapted to engage one of the series of notches.

VALVE.—H. A. WOOD, address King and Smythe, 71-73 Clarence St., Kingston, Ont., Canada. The invention relates to valves for fire extinguishers and the like, the object is to provide a valve which may be used in connection with any container for fluid under pressure, the valve being so arranged that it will prevent any escape of the fluid when in closed position and which may be easily opened to permit the escape of the fluid.

Household Utilities

BED RAIL.—F. N. MARTIN, Newberry, S. C. The invention has for its object to provide a device wherein means is provided in connection with the bed posts and the rails, for permitting the rail to be reversed, in order that the rail may be used with springs or with slats. The special shape of the lugs and notches insure a perfect tight fit, pressure on the rail will have the effect of tightening the joints.

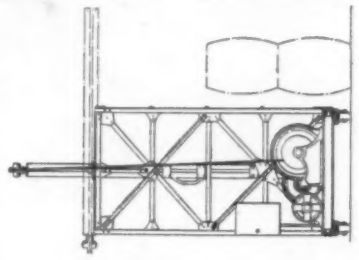
Machines and Mechanical Devices

STAMPING MACHINE.—N. and L. DE SANTIS, 77 High St., Brooklyn, N. Y. The object of the invention is to provide a stamping machine more especially designed for use in stamping fabric, to dispense with the expensive handwork now generally employed and arranged to facilitate the stamping to turn out a large amount of accurately stamped goods without the aid of skilled labor.

APPARATUS FOR DRYING TOMATOES AND FRUIT.—T. J. PETERS, Miami, Fla. The invention has for its object to provide an apparatus which will quickly and thoroughly dry tomatoes and fruit, after they have been washed to remove the leaves and dirt. The apparatus works automatically without the slightest injury to very tender fruit. The tomatoes are carried along by a conveyer belt to which sponges are secured, and pass beneath flexible members to which also a plurality of sponges are secured.

MACHINE FOR STITCHING GAS-MANTLES.—J. PARTMANN and S. BALADA, 81 Bleecker St., New York, N. Y. The invention has for its object to provide a machine which has hooks which are moved into needle eyes after the needles are pushed through plaits in the mantle made by plaiting members so that a thread may be disposed in the hooks to be drawn through the needle eyes when the hooks are withdrawn prior to the withdrawal of the needles from the mantle plaits which stitches the mantle.

STACKING AND UNSTACKING DEVICE.—M. F. GROSS and D. RICHARME, Gramercy, La. This invention relates to devices for stacking or unstacking barrels and packages of different kinds in warehouses to fill the height of any floor space. An object is to provide a construction which may



A SIDE VIEW OF THE DEVICE

be easily and quickly operated, and easily moved from place to place. The device is provided with a pivotally mounted framework movable to a horizontal plane in order that it may pass beneath comparatively low parts of a building.

APPARATUS FOR RAISING SUNKEN VESSELS.—J. H. MCPARTLAND, St. John, N. B., Canada. The prime object of the invention is to produce an apparatus in the form of a submergible marine vessel of the catamaran type adapted to be positioned over the vessel to be raised so that the latter will occupy the space between the spaced hulls of the catamaran, the respective hulls having gripping means operable from the interior of the hulls to engage the sunken vessel, whereby as the catamaran rises following the ejection of the submerging water, the sunken vessel will be raised

Musical Devices

BANJO ATTACHMENT.—W. B. FARMER, 255 W. 126th St., New York, N. Y. The object of this invention is to provide an attachment for a banjo or similar musical instrument, arranged in such manner as to enable a player to produce an exceedingly sharp, clear, yet melodious tone. Another object is to permit the owner of a banjo to conveniently and readily apply the attachment to the banjo without the aid of a skilled mechanic.

Railways and Their Accessories

CAR DOOR LOCK AND SEAL.—F. H. DAY, 37 S. Howard St., Baltimore, Md. The invention relates particularly to car door locking devices embodying a seal in connection therewith, and so constructed as to necessitate the use of a key for unlocking the door, in addition to breaking the seal, the object being to provide an arrangement whereby to obviate the present conditions under which members of train crews may obtain unwarranted access to a car by simply breaking the seal.

Pertaining to Recreation

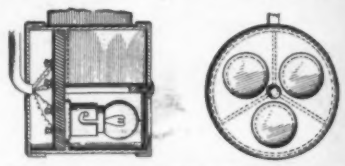
SKII STIRRUP.—E. P. ASHLEY, Woodstock, Vt. The invention has for its object the production of a skii stirrup having two plates, one adapted to be secured to the heel and the other to the toe of a shoe, the plates being connected by a flexible member which will permit of a limited lateral movement of the heel plate, relatively to the toe plate, to relieve the strain on the ankle of the user, should he fall. The device may be adjusted to fit the skii to be used, as well as being adjusted to the shoes of the user.

AMUSEMENT DEVICE.—C. P. NEATS, 89 Sanford St., East Orange, N. J. The particular object of the device is to provide a construction whereby a bale may be projected by air pressure to a distance proportionate to the power exerted by the blow. Another object is to provide means for quickly compressing air beneath the bale, a further object is to provide a device which may be struck by a mallet for causing a quick supply of air under pressure to act on a bale causing the same to be moved through the air.

Pertaining to Vehicles

TIRE CHAIN AND ARMOR.—W. J. PUTNAM, Deposit, N. Y. The invention has for its object to provide a device adapted to be used with tires of any character for preventing skidding and slipping and for increasing the traction of the wheels, wherein a series of similar connecting or non-skid members is provided, each consisting of superposed space plates having means for engagement by the links for connecting the plates to each other, and means for clamping the holding for the armor on to the tire.

SIGNAL LAMP.—H. R. ANDREAS, Malolos V Bulacasy, Manilla, P. I. The object of the invention is to provide a device whereby an automobile driver may easily signify from the rear of his car to following automobiles or other vehicles his intention to slow down and stop, or of changing direction by turning either to the right or left,



FRONT VIEW AND SECTION OF THE DEVICE

without diverting his attention from the proper management of his own car, thereby materially contributing to the safety of his car and those of others following in crowded traffic.

WHEEL RIM.—W. S. WATSON, Hippodrome Bldg., Cleveland, Ohio. An object of the invention is to provide means for securing metal spokes to steel rims. A further object is to provide a construction in which the cost of production is reduced to a minimum without sacrificing strength or rigidity of the connections, to provide means by which the parts may be assembled by unskilled labor, and to provide a rim which dispenses with the necessity of riveting or welding any of the connecting parys to the rim.

SPRING WHEEL. W. S. WILLS, Covington, Va. The object of the invention is to provide a spring wheel especially adapted for railroad, automobile and heavy traffic work which will possess a maximum of resilience, without weakening the structure, and wherein there will be no danger of injury from outside sources. The invention comprises a hub and rim, with a plurality of cushioning devices between the hub and the rim, these devices being in the form of resilient rings.

SHOCK ABSORBER.—D. F. OLIVER, 2610 E. 14th St., East Oakland, Cal. The invention relates to means for resisting jars and shocks, one of the main objects is to provide such devices which not only resist shocks but which yield to the shock inversely to the force thereof, a further object is to provide such devices which are normally non-resistant, the resisting elements being only brought into action by sudden jars or shocks thereby permitting a normal, unimpeded, movement of the parts upon each other.

ROAD VEHICLE WHEEL.—S. H. COPE, Birmingham, England. The invention relates to wheels fitted with twin pneumatic tires, that is to say, a pair of tires which are mounted one alongside the other on the rim of the wheel. The object of the invention is to provide means for preventing the lodgement of stones between the twin tires, to overcome this a detachable rubber filling ring of smaller outside diameter than the tires is provided, this ring has concave sides and is shaped to fit closely between the pneumatic tire surfaces.

TIRE SPRING.—C. L. SACKRIDER, 476 Lake Ave., Battle Creek, Mich. The invention relates to spring means adapted to be inserted in a tire casing to act as a substitute for a pneumatic inner tube. More particularly the invention relates to a tire spring having series of spring elements alternating with each other and restraining means in the form of side rings to which the respective series are connected, the said elements being in bowed form and overlapping at their inner ends to bear directly against the demountable rim.

Designs

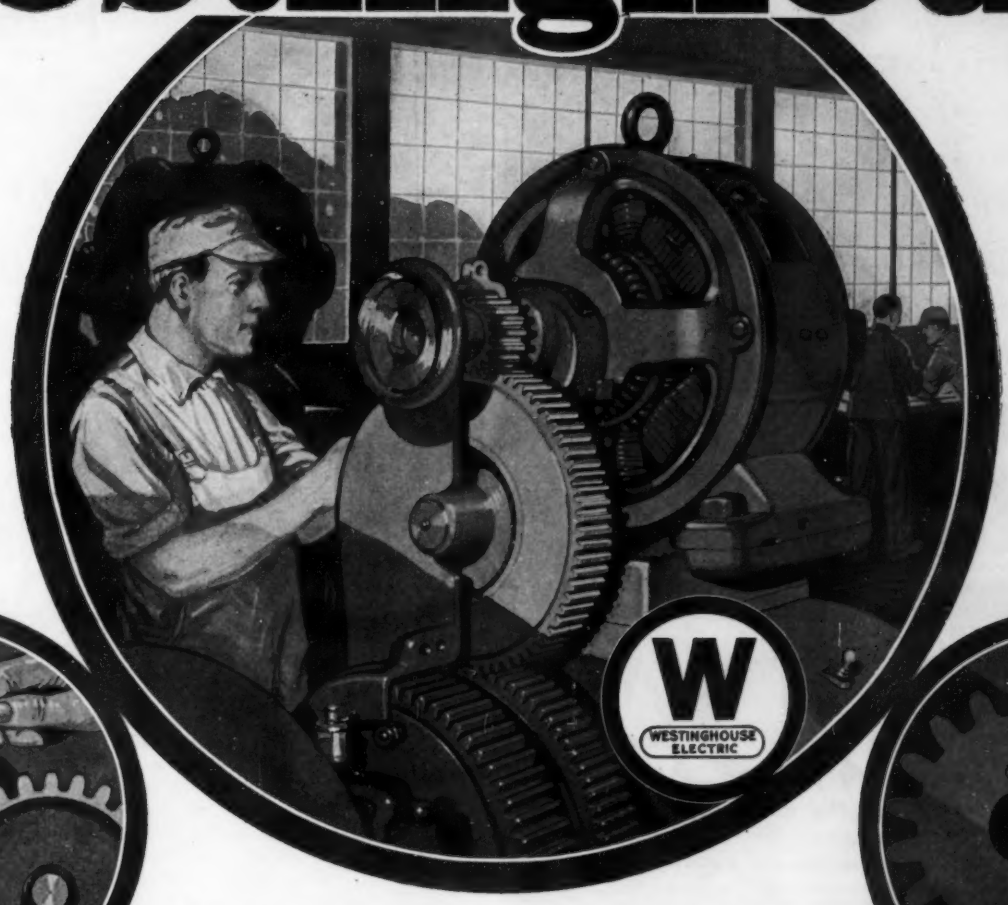
DESIGN FOR A FINGER RING.—J. SIMMONS, 26 W. 60th St., New York, N. Y. This ornamental design which is intended to be produced in gold or other metal, for holding a diamond or other stone, shows a claw form for retaining the stone, the open spaces between the claws representing hearts.

DESIGN FOR A LAMP.—N. LIPSKY, 160 John St., Brooklyn, N. Y. This design shows a very ornamental form of lamp shade produced in metal and colored glass, with a base to harmonize. The inventor has been granted two patents, Nos. 51,902 and 51,903, both of a similar nature.

DESIGN FOR AN AUTOMOBILE BODY.—C. T. SILVER, care of J. M. Lowestein, 149 Broadway, New York. The design as shown in the plan view accompanying the patent, represents an elliptical form of seating space, providing a driver's seat, a seat corresponding, and a rear seat for three persons.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Westinghouse



Though non-metallic, Bakelite Micarta Gears can, and should be, well lubricated. The life of a well lubricated gear is from two to five times that of a non-lubricated gear.

Bakelite Micarta Gears are the only non-metallic gears that are self-supporting, requiring no shrouds or end-plates, under ordinary conditions.

Noiseless Gears that Last

Silent operation and long life.

Long life and silent operation.

Put them in either order, you will find the answer in Bakelite Micarta Gears.

If the essential quality of the gear or pinion is quick running, Bakelite Micarta Gears are just the thing for your service, for there are no quieter gears made.

If ability to stand up month after month is the chief consideration, you will find that Micarta Gears compare favorably with untreated steel, cast-iron or bronze under ordinary conditions, outlast metal where sand or grit is encountered, and wear longer than other non-metallic gears.

Moreover, they greatly lessen the wear on the metal mating gear.

Micarta Gears are the only non-metallic gears that are self-supporting, and that do not ordinarily require bushings or flanges.

They will not shrink, swell or warp out of shape.

They can be operated in oil without injury or lessened life, their oil absorption being practically zero.

To these advantages then add many others: They can be used where other non-metallic gear material cannot—they are not attacked by rodents—they are not affected by acid or alkali solutions—they can be kept in storage indefinitely without deterioration.

Where They Are Used

Micarta Gears are in use in many different applications in many different fields—for automobile equipment, in textile mills, in machine shops, in foundries, mines, paper and pulp mills, and various other places.

They can be substituted for untreated steel, cast-iron, bronze or other non-metallic gears in a large majority of commercial applications.

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Bakelite-Micarta Gears and Pinions

The Current Supplement

THE history of the world is a continuous record of wars. Among nations the decisive factor of their rise, existence and, too often, their disappearance has been war. If we turn to the animal or the vegetable world we find the same conditions; and there is constant conflict among the elements. Moralists may be right in their theories, and while they may at some future time, eliminate conflicts between different peoples, they cannot by any possibility change the character of the universe, and the inhabitants thereof must make up their minds to continue the fight against the powers of nature that oppose human plans in so many directions. In this connection an interesting paper on *The Wars of Insects* will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2209 for May 4th, which shows how the struggle for existence involves every living creature. *Where Germany Is Obtaining Indispensable Supplies* gives a few facts that show why the sea blockade has not sufficed to end the war, and points out a fundamental error in the plans of the Allies. Several illustrations accompany this note. *The Enclosed Observing Room* will interest many astronomers who have suffered the discomforts of working in inclement weather. The article is illustrated by a number of diagrams. *Human Aids to Machinery* is a valuable paper on a phase of industrial engineering of importance in these days when efficient production is of such vital importance. *Some Familiar Bird Friends* give us much valuable information about the Nuthatches and Chickadees, so familiar to most dwellers outside the cities, and a number of unusual photographs add to the interest of the story. The constantly increasing number of women that is being utilized in factories producing war munitions raises many new problems, and some of these are discussed in a paper on *The Employment of Women in Munitions Factories*, which was recently read before an English technical society by a woman who has made an extensive investigation of the subject. The protection of ships against underseas attacks is one of vital importance. Some of the problems involved are discussed in an article on *Merchant Ship Design and Torpedo Attack*, which is based on a report of a committee of the British Institute of Naval Architects that contains much valuable matter. *War Aviation* reviews the experience of a British expert, and shows some of the great advances that have been made of late years. Ships built of concrete is one of the sensational topics that is being widely discussed, and about which there is naturally great differences of opinion, which is but natural as it is a matter on which no definite information exists. The paper on *Ferro-Concrete Ships* is by a French engineer, and is probably the best review of the subject that has yet appeared. This issue also contains a number of valuable short articles.

Coal and Electricity in Double Harness

(*Concluded from page 408*)

But, whereas in Lancashire, with its multiplicity of electrical undertakings, the price per unit for electric power varies from a penny to two pence or more, the average price paid in the northeast coast district is less than a half-penny a unit, and the use of electric power per head of population is three times as great. A great saving of coal and reduction of smoke has resulted. Apart from the electric-power companies' consumption, practically no coal is burnt on the Tyne for power purposes, except by the railways and some collieries. The Tyne shipyards may be said to have adopted electricity to the exclusion of all other forms of power. As a result of the adoption of electric traction on the suburban railways, the traffic facilities of the district are greater than those of any other district of similar size. New industries have been established in the district, solely on account of the cheap electric power available. Waste heat and gases have been extensively used for the production of electricity, so that electric power is produced as a by-product of two of the

largest local industries—the making of pig-iron and coke. These local generating stations are commonly called "waste-heat stations." The first was erected in 1905, and there are now 11 at work.

The Committee foresees, as a result of a national system of electric-power supply, a great increase of the use of electricity for all purposes, with many advantageous results. Factory chimneys would gradually disappear. Railways would be electrified, even for the haulage of goods trains. Smoke would disappear from towns and coal wagons need run no farther than to the electric-power stations. Electric light would be cheap enough for the poorest, and there would be a large increase in the use of electric heat and power for household purposes.

As showing the importance of the scheme the report says: "It is scarcely possible to exaggerate the national importance of a technically sound system of electricity supply, because it is essentially one with the problem of the industrial development of the country. The development of such a power system may be likened to the development of the railways of a country, and it is just as impossible to secure economical power generation and supply by each municipal area working independently (which is the position today) as it would be to have an efficient railway system if each municipal area owned its own lines and long-distance transport were provided for by traffic and operating agreements. History shows that, in the early stages of railway development, exactly the same process of amalgamation had to be gone through."

Even as it has been found advisable in the United States to requisition a certain portion of the electrical power supply obtained from the Niagara Falls and to organize and employ the railway transportation system under a single authority and a simplified method of coördination, so it may be found advisable both in the United States and in Great Britain to make coal and electricity run in double harness under one guiding central authority for the complete mobilization of the national resources and the economic conservation of the coal supply in each country, in opposition to the present decentralized and inevitably wasteful method of its utilization.

Getting the Most Out of the File

(*Concluded from page 410*)

of the angle of the cutting surface and, in consequence, increased output. Fourthly, the original surface of the file being deformed in the tempering operations, there are certain spots or zones which cut and others which do not. Fifthly, the speed of the file stroke has considerable influence, since in the case of a reduced speed the teeth slide over the work and penetrate a lesser distance into the metal. The normal speed should be 60 strokes a minute.

The hardness of the metal being filed has a somewhat paradoxical influence on the amount of filings, in that the hardest metals give the greatest volume. The reason is that the hard metals are cleanly cut by the file's teeth, while the softer ones after being cut are mashed into the hollows of the file surface, cutting down the filing properties of the tool. At any rate, the labor expended for 100 strokes of the file diminishes with the hardness of the metal filed, as is shown from the following figures of M. Fremont:

Resistance of the Steel	*Weight of the Filings*	*Energy Applied*
39 kilograms	7.130 grams	155 kilograms
55 "	8.400 "	123 "
70 "	10.040 "	105 "
100 "	11.950 "	87 "

In general, the teeth of a file are produced by two cross cuts. The first cut, made at an angle of 45 degrees, is destined to limit the size of the teeth which are produced by the second or cross cut, which forms an angle of 110 degrees. The harder the metal used in the file, the greater the resistance of the teeth to wear. That is why users of files are continually looking out for the hardest steel and the best temper in the tools they purchase. In the course of his experiments M. Fremont discovered the interesting fact that with a given file its useful life was about 25,000 strokes, or about two working days of 10 hours each. Furthermore, he made an important comparison between the work turned out by that file and another new file of the same kind, with the result that the old file turned out a certain weight of filings at about twice the cost of the same quantity turned out by the new file. Counting the workman's time and the overhead charges, the new file, even after adding its cost, proved capable of turning out the work at something like $4.60 as compared to $10.60! So it is of prime importance that workmen should discard files the moment they have passed their period of efficient life, although it is admittedly difficult to determine the exact moment when they should be discarded.

The work of M. Fremont would seem to indicate that users of files, as well as the manufacturers of these tools, should have a more definite knowledge of the subject. The former ought to know how much filings a given file produces per 100 strokes, while the latter ought to know various facts in order to alter file designs to meet various requirements. For example, large users of files and manufacturers of same would do well to make experiments with files of various kinds, using one of each to the point of practical uselessness while making records of the filings obtained for so many strokes and the work and pressure expended.

The French government, a large purchaser of files, has gone in for file testing on an elaborate scale. However, until recently the tests have only been of comparative value, and have told nothing of the economic results. It is necessary, in order to know the value of a file, to make a test with a machine that registers the work expended on the file, with a pressure approximately that brought to bear by the workman, say 5 kilograms, with a practical speed of 60 to 70 strokes per minute, which is a practical working speed. The weight of filings obtained in this manner can then be taken as a factor of economic value, since other conditions are known. Furthermore, all the faces of a file should be tested, and for the most accurate readings not 100 or 200 strokes should be the test run, but 1,000 or 5,000 or even 10,000, so as to obtain an average which approaches more nearly the actual conditions of the shop.

Unfortunately, such a procedure is time-consuming and costly. At least it would be if M. Fremont had not developed a testing machine which greatly shortens the testing period by making use of greater pressures, say 100 kilograms instead of 25, or filing a metal of greater hardness such as steel or even chrome nickel steel. The machine, which appears in the last illustration, is operated by a motor at the rate of 60 strokes per minute. The work is registered on a chart as shown. With such apparatus the two faces of a file can be thoroughly tested in about an hour and a half, while a less complete test, say of only 100 strokes, can be consummated in half an hour. It is also of importance to note that the file, not being subjected to the long run called for by other methods, can still be efficiently employed for filing soft steel and iron. All in all, this machine is ideal for file manufacturers and large users of files, who wish to obtain some real information concerning their tools.

Calculations for the Farm Engine

(*Concluded on page 413*)

Thus, suppose two shafts are connected by a chain and sprocket. The driver shaft turns at 200 r.p.m. and has a 10-tooth sprocket. What sprocket is necessary for the driven shaft if a speed here of 125 r.p.m. is wanted? We substitute in the formula, and have

$$200 \times 10 = 125 \times t$$

$$2{,}000 = 125 \times t$$

$2{,}000 \div 125 = 16$ teeth for the driven sprocket.

If the result should happen to come out, say, 16.2 teeth, we would use a 16-tooth sprocket; if it should come 16.8, we should install a sprocket with 17 teeth.

If a speed indicator is used, it is a simple matter to determine correctly the speed of

an engine or a driven machine. In its absence, an easy way to determine the speed of a single-cylinder volume-governed engine is to count the explosions occurring in a minute and multiply by 2; the result will be the r.p.m. Another device to determine the speed of any shaft is to tie a long thread near the tip of a pencil, having a rubber eraser. With a watch in the other hand, hold the rubber tip of the pencil in the center of the revolving shaft and allow the thread to be wound up on the pencil for exactly ten seconds. Remove the pencil quickly, count the number of turns of thread on it, and multiply by 6 to get the r.p.m. The trial should be repeated two or three times in order to obtain a fair average.

Another question has to do with the proper width of belts. It is easy to say, "I guess a three-inch belt will be about right for this job," but the present high price of belting should be an incentive to obtain a belt of precisely the correct width for the work that it is to do. This correct width may be determined by use of the formula:

$$P = V \times W \div 1{,}000,$$

where P represents the horse-power to be transmitted, V the velocity of the belt in feet per minute, and W its width in inches. When not directly known, V may be found by multiplying the diameter of the driver pulley (expressed in feet) by 3.1416. This gives the number of feet travel per revolution, and must be multiplied by the r. p. m. to give the rate of travel per minute. The numbers 1,000 and 3.1416 in this case are fixed quantities, determined by experiment, and valid for all cases.

An example of the use of this last formula is to be found in a case like the following. An engine running 400 r.p.m. has a 10-inch pulley and is to transmit 4 horsepower. What width belt should be used?

The first thing to do here is to reduce the diameter of the pulley to feet. For this we have 10 inches = 10÷12 = .83 feet. Then to get V we find .83 × 3.1416 = 2.61 feet per revolution, cutting off the multiplication at the second decimal place. Finally, in the formula,

$$4 = \frac{2.61 \times 400 \times W}{1{,}000}$$

Clearing of fractions,

$4{,}000 = 2.61 \times 400 \times W = 1{,}044 \times W$

$4{,}000 \div 1{,}044 = 3.8$ inches for the width of the belt.

Accordingly we will use a 4-inch belt, as the nearest commercial size.

Palm Fiber for Brushes

QUITE a fair trade has developed in what is known as "palm fiber" in Hongkong with the United States for the manufacture of brushes. The material is the center of the leaf stem of the small palm (*Livistona chinesis*), which grows wild over much of the South China hill country and which is generally cultivated in some districts for its leaves—the common palm-leaf fan of commerce. The fiber is obtained simply by soaking the stem and stripping off the outside portion. The fiber in the stem is then cut into convenient lengths and shipped in bundles of about 200 pounds each. At present (January 28th, 1918) it sells wholesale at about 17¼ cents local currency (at present exchange about 12¼ cents gold) per pound. The fiber is used locally and in fact all over South China in the manufacture of what are popularly known as "bamboo brooms," and for Chinese scrubbing brushes and similar articles.

A Pet Sheep Instead of a Dog

TAX records in one county of Kansas, show that it has a population of 6,000 dogs, which consume enough food each day to feed 1,000 Belgian orphans, or $34 a year per dog. The county has only 2,000 sheep. A sheep can be raised for the cost of a dog. It is just as good a pet as a dog, and will yield $5 worth of wool yearly and $10 worth of meat when killed, as against a merely nominal killing value on dogs in case their hides are turned into gloves. These striking figures are used as a plea for fewer dogs and more sheep. The replacement of these dogs with sheep would save $18,000 worth of food per year for that county alone.

Enough Corn Meal for the Nation

ACCORDING to an estimate made public by the United States Food Administration following a canvass of the whole country the actual milling output of corn meal increased from 3,000,000 barrels in October to nearly 6,000,000 barrels for the month of March.

The estimated maximum capacity for milling corn meal in the United States mills running 24 hours per day, 30 days per month, exceeds 9,000,000 barrels per month, an increase of 200 per cent over last year.

In view of this great output, Americans are now in a position to observe total abstinence from wheat flour and depend wholly on corn meal and other corn products as their source of breadstuffs. Our normal consumption of wheat flour is 8,000,000 barrels per month.

It is estimated that during the past 18 months the output of corn flour has increased 500 per cent. The estimated production of corn flour for October and for March is placed at 250,000 and 540,000 barrels, respectively.

There is now enough corn meal being turned out to care for all demands in the United States. The remarkable increase in output, which is certain to become greater each succeeding month, is due in considerable part to the conversion of much wheat-milling machinery into corn-milling machinery.

Shortage of Farm and Garden Tools in England

THE supply of farm and garden tools on sale in the shops in Great Britain appears to be considerably smaller than last year, notwithstanding that by improving the organization of their resources the British manufacturers have increased their output, particularly of hoes, sickles, and hooks, during the winter months. Owing to the continued demand throughout what was formerly the off-season, it has been impossible to accumulate stocks for the spring trade, with the result that the execution of most of the orders is said to be three months in arrears.

The domestic demand, which will continue until the end of April, is appreciably heavier than in 1917, because a large acreage of grassland has since been put under cultivation, and the allotment movement has extended.

On nearly every available space in and near the towns and cities small vegetable gardens, known as "allotments," were seen last year, and the threatened food shortage will tend greatly to increase the number during the 1918 season.

Very few amateurs' sets of small garden tools will be on the market, makers having limited their output to tools for producing food.

A new feature in the trade has been the heavy buying of sycthes, spades, forks, rakes, and hoes by the Government for use in Mesopotamia and other distant war zones, where the troops have cultivated the land near the camps. The output of farm and garden tools may suffer in the near future by the operation of the new man-power scheme, but whether more men will be taken from the tool trade remains to be seen.

It is probable that the British export trade in farm and garden tools will be considerably affected during the present year by the prohibition of exports of this sort of articles. Tool handles have entered largely into this trade, but the director of the War Trade Department has now given notice that, on account of the large supplies of handles required for the army and for essential civil purposes, and also in consequence of the considerable importation required to meet the demands, further licenses will not be issued for the present, other than in the most exceptional circumstances, for the export of handles exceeding 24 inches in length, or for any tools that have been fitted with handles of the kinds specified.

Since February 1st, 1918, import licenses have been issued on a ration basis, *i. e.*, the amounts permitted will bear a fixed proportion to the quantity imported by the various importers during previous years. Under these circumstances, notwithstanding the present active demand for farm and garden tools, there is little probability that American manufacturers will be successful in increasing their present shipments of tools to the United Kingdom. In view of the shortage, however, it might be to the advantage of American manufacturers to take up the matter with a view to supplying goods when shipping conditions are more favorable. There are transmitted the names of several firms, usually holding large stocks of imported hardware, who may be interested in American farm and garden tools.

Cooking Stoves in Paraguay

THE "stove" in universal use in Paraguay consists of a brick fireplace built in one side of the kitchen, on the top of which are open fire holes, over which the cooking is done. Charcoal is the fuel chiefly used. As no baking can be done on the "stove" in this form, special facilities must be provided, which usually consist of a small earthen oven built near the kitchen, or one made of metal, which is placed over the fire of the stove when baking is required.

Some homes are provided with a kind of an iron stove made in the country which is usually built into one end of the ordinary kitchen stove or fireplace, in addition to the ordinary stove as above described.

The use of imported stoves or ranges is confined chiefly to the foreign population. Many of the foreigners, however, find it more satisfactory to use the ordinary native stoves owing to the high duty on imported stoves and because the servants of the country are accustomed to cooking on native stoves.

The official statistics of 1916 show that only three stoves were imported during the year. As each of the hardware houses of Asuncion carries several stoves, or ranges, in stock, the average number of stoves imported in a normal year must be considerably more than three. It is fairly certain, however, that Paraguay does not offer a promising market for cooking stoves, ranges, or fireless cookers.

Water Power in Denmark

DIFFICULTIES of importing coal have developed many heretofore unprofitable sources of power, heat, and light. The most important of these is the peat bogs in the western part of Denmark. In Norway and Sweden water power is developed to a great extent for the production of electricity, but in Denmark there are no waterfalls of consequence. It is reported that Gudenaa, a small river in the vicinity of Aarhus, is about to be developed by the municipality of Aarhus at a cost of $1,000,000. It is expected that about 1,000 horsepower will be utilized.

Development of Coal Deposits in Algeria

THE scarcity of coal and other combustibles in Algeria has given special impetus to the movement for the development of the coal and lignite fields of the country.

The coal deposit in the region of Colomb-Bechard, in the southwest of Algeria, bordering Morocco, where a large field has been though to exist, is, according to the bulletin of the Government-General of Algeria, to be exploited in the near future. This region was discovered 20 years ago by an engineer named Flamand and has been recently explored by the officer in command at Bel-Hadi.

The particular deposit under consideration lies on the border of the oasis of Kenodja and appears to be over 8,000 feet in length and 1½ feet in thickness. It is estimated that there are 10,000 tons that can be extracted by surface workings. The coal seems of fair quality. A test has been made on the railroad between Bechar and Ain-Sefra, two tons of the coal being used with 300 kolos (660 pounds) of briquets and giving satisfactory results.

Lignite occurs at several points in Algeria. A considerable quantity has been extracted from the deposit near Cherchell, and in the Department of Constantine some progress has been made.

NEW BOOKS, ETC.

AGRICULTURAL BACTERIOLOGY. A Study of the Relation of Germ Life to the Farm with Laboratory Experiments for Students. By H. W. Conn., Ph.D. Third Edition, Revised by Harold Joel Conn. Philadelphia: P. Blakiston's Son & Company, 1918. 8vo.; 367 pp.; illustrated. Price, $2 net.

The importance of bacteriology to agriculture is unquestioningly conceded; much progress in certain details of the relationship has recently been made, only to open up still wider fields of investigation. The death of the author of this well-received text left its revision to another hand, but the gratifying statement may be made that the revision has been competently carried out. The work sketches the general character and activities of the bacteria, yeasts, and higher fungi, interestingly discusses bacteria in soil and water and in dairy products and the parasitic diseases of plants, and furnishes an appendix that will prove a reliable guide to laboratory work and disinfection.

PLANE TRIGONOMETRY WITH TABLES. By Eugene Henry Barker. Philadelphia: P. Blakiston's Son & Company, 1917. 8vo.; 172 pp.; illustrated. Price, $1 net.

The head of the Department of Mathematics of the Los Angeles Polytechnic High School has prepared this text with a view to thoroughly familiarizing the student with trigonometric functionality, acquainting him with the interdependence of the functions, and imparting a knowledge of the methods of analysis, an initiative in the development of formulas, and a skill in their application to practical problems. Logarithms are made the subject of extended treatment, the tables are designed to promote maximum efficiency with a minimum of labor, and interest has been so maintained as to make the work a gateway to higher branches of the subject.

SCIENTIFIC OFFICE MANAGEMENT. By W. H. Leffingwell. New York, Chicago and London: A.W. Shaw Company, 1917. 4to.; 253 pp.; illustrated. Price $10.00.

OFFICE MANUAL. Including Policy Book and Standard Practice Instructions. New York, Chicago and London: A. W. Shaw Company, 1917. 8vo.; 55 pp.

For thirty-five years the late Frederick W. Taylor devoted himself to the development of a type of factory management now well known as the Taylor system; for ten years the author of this work has applied the principles of the Taylor system of scientific management to office work, including planning, analysis, time and motion study, and task and bonus plans; this volume contains a full report of the accomplishments. He finds that "Time and motion study reveal just as startling results in the ordinary details of clerical work as they do in the factory," and that in complex mental problems the task and bonus plan has proved as successful as in routine clerical work. He gives concrete examples of the results secured in offices, and tells of the handling of 60 letters an hour where only 20 could be written before. Better light, standardization of equipment, shrewd planning, task-setting, the handling of stores, advertising and sales, shipping and traffic—these are some of the subjects treated; folding inserts offer stimulations to better work, organization charts and office lay-outs, and four separate pamphlets on lighting, ventilation, advertising department records, and credits, collections and complaints, supplement the valuable studies of the main volume. The 'Office Manual" gathers together policies and rules that have stood the test of time and is full of suggestions that should greatly benefit any business, large or small.

WHAT EVERY SOLDIER OUGHT TO KNOW. By Captain T. J. J. Christian, Seventy-ninth Field Artillery. Kansas City, Mo. Franklin Hudson Publishing Co., 1917. 12mo.; 153 pp.; illustrated.

The war data of the first part of this little volume includes material relating to pay assignments, mail, foreign money and measures, rank and precedence of officers, insurance, the articles of war, principles of infantry training, target practice, the care of the rifle, signaling, etc. There is also a short French vocabulary, some hints on sketching, and a calendar. The second part carries a war diary, insurance data, and information concerning compensation, indemnities and family allowances; in a pocket at the back of the book is a sketching scale and a war map of Europe.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION. 1916. Washington, D. C.: Smithsonian Institution. 8 vo.; 619 pp.; illustrated.

The somewhat forbidding title of this annual may repel the general reader; that would be a great pity. It is true that a small portion of the work is devoted to the establishment, administration and finances of the Institution, and that the purpose of the volume is primarily the diffusion of knowledge rather than the giving of entertainment; but the body of the book provides instruction on a variety of subjects in such a readable way that it also furnishes the best kind of entertainment to the intelligent reader. In *News from the Stars*, C. G. Abbot tells of light, the messenger that brings the news; of the message, "in cipher, very long, faint, and hard to read;" and of how that message is interpreted with the aid of the wonderful instruments astronomy has developed. Other papers deal with the distances of heavenly bodies and the way in which the stars are counted, with excellent folding plates. There

are no less than 27 interesting articles by authorities, on subjects varying from gun report noise to the problem of evolution; even the average boy will eagerly devour the old yarns of the squid and the octopus, as told by Paul Bartsch in "Pirates of the Deep," and may incidentally learn facts that are as strange as the strangest fiction. Matters intimately connected with everyday life are not neglected, but are ably handled in such papers as "The Petroleum Resources of the United States" and "The Outlook for Iron." Beautiful plates add to the attractiveness of the report, and it is to be hoped that the public may be taught to look for its annual appearance with the eager anticipation it merits.

THER'S INTERNATIONAL CODE GUIDE. Chicago: The John A. Hertel Company.

This device is in the form of a thin metallic tablet of convenient pocket size, upon which is graved an ingenious diagram that will enable any man to decipher dot-and-dash messages as they are sent. It is easy to conceive of a military situation in which the wounding or killing of the signal corps of a company that had received orders to attack made it impossible for the company to understand code signals countermanding such an order, and in this case the company would carry out the original command and advance, unsupported, to their destruction. Indeed, it is claimed that instances of this kind have actually happened on the Western front. The desirability of a device that makes it possible for any soldier to read code messages is apparent, and there would seem to be a distinct field of usefulness awaiting this Guide.

INTERNAL COMBUSTION ENGINE MANUAL. By F. W. Sterling, Lieutenant Commander, U. S. Navy, Retired. Washington, D. C., 1917.

This is the fourth edition of a text that has been successfully used for eight years at the Naval Academy, and the new edition has presented an opportunity of incorporating much new material. Since fuel governs both design and operation, solid, liquid and gaseous fuels are comprehensively dealt with; then the engine itself is treated under the divisions provided by the four systems—fuel, ignition, cooling and lubrication. The work is illustrated lavishly but with sound judgment, the plates showing aerial motors being strikingly good. The text is excellently adapted to the purposes of instruction and demonstrates the author's unfailing ability to pick the vital from the insignificant. Among the added material is a chapter on the airplane engine in which the five types, vertical, horizontal opposed, V-type, radial and rotary, are described in their most up-to-date embodiments. Facts and fundamentals are simply explained, and the logical sequence and clear exposition will appeal to the uninitiated.

HOW MONEY IS MADE IN SECURITY INVESTMENTS. By Henry Hall. Published by the Author from 52 Broadway, New York, 1916. 8vo.; 288 pp.; illustrated. Price, $2.50.

To buy when stocks are low, and to sell when they ae high, is excellent advice; to carry the advice into successful practice demands a knowledge of many factors too frequently ignored. These factors are very thoroughly discussed by the author of the work in hand, including the fundamentals of money, earnings, crops and business, domestic and foreign trade, tariff laws, competition, and gold production. The lessons of financial history are emphasized and made to serve present ends; much valuable statistical information is conveyed by tables, diagrams and charts, and the general aim is toward safe investment that is also good speculation. The theory of economic cycles is expounded, and on the whole the book offers to the young man, or to the business man too absorbed in some specialty to devote any considerable portion of his time to the investment market, a compilation of sound principles and concrete suggestions that, with a fair amount of good judgment on his part, will enable him to avoid costly mistakes and cultivate that foresight without which it is most foolish to expect even a moderate success in any untried field.

PRINCIPLES OF OCEAN TRANSPORTATION. By Emory R. Johnson, Ph.D., Sc.D., and Grover G. Huebner, Ph.D. New York and London: D. Appleton and Company, 1918. 8vo.; 534 pp.; illustrated. Price, $2.50 net.

Many volumes, some technical, some popular, deal with various phases of ocean transportation; here is one that is comprehensive although, of course, not exhaustive, to which the college student, the steamship man and the shipper may all turn with the assurance of finding accurate information coupled with references to standard publications that go into further detail. The writers, who are professors of Transportation and Commerce in the University of Pennsylvania and accomplished authors of works on commercial and agricultural subjects, describe ocean carriers and their services, give an account of ocean conferences and an explanation of rates and fares, and impartially examine the principles and practices of government aid and regulation of shipping. The arrangement of material is adapted to meet either individual or classroom requirements, and all important forms, such as manifests, invoices, bills of lading, and vessel and cargo insurance policies are faithfully reproduced. Folding maps show trade routes and distances by the Panama Canal and other routes, and the coaling stations of the world; other folders diagram passenger and freight agreements in the North Atlantic trade, and there are valuable tabulations of comparative tonnage, the financial statements of representative passenger lines, and port charges. In style the work is simple and understandable, and it would seem to meet a need that has long been felt, and long been unfilled.

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